WATER & SEWAGE WORKS

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL

Winnipeg's Radio Control and Record Room

For Utmost Security

IMPORTANT AMERICAN CITIES INSTALL

LOCK JOINT

CONCRETE PRESSURE PIPE

More than anyone else, those responsible for supplying water for domestic or industrial use appreciate the value of pipe lines which provide these four freedoms:

Freedom from:

- ★ Rupture or blow-out
- ★ Maintenance and repairs
- ★ Loss of carrying capacity
- ★ Corrosion or deterioration

The water works man who installs Lock Joint Concrete Pressure Pipe will have trouble-free pipe lines. The careful design of Lock Joint Pressure Pipe does not permit blow-out or rupture, its dense concrete walls are immune to tuberculation, corrosion or electrolytic attack, and its useful life has been estimated by competent hydraulic engineers at more than 100 years. Among Lock Joint's strongest supporters are the water works officials who have installed this type of pipe and who point to it as the most economical in their systems.

• • •

If you are quality minded yet cost conscious, specify Lock Joint Pressure Pipe, secure in the knowledge that you are receiving the best value the pipe industry can provide.

LOCK JOINT PIPE COMPANY
Est. 1905

P. O. Box 249, East Orange, N. J.
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SCOPE OF SERVICES—Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipes of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.

The Only Large Capacity Oscillating Piston Meter

Rockwell employs the time-proven oscillating piston principle in Type 16 Empire meters. Users say the Empire has no equal for low flow accuracy and lasting durability. Empire Type 16 meters earn more revenue by turning dribbles into dollars. Maintenance records in many plants show that this design requires less repairs and fewer replacements.

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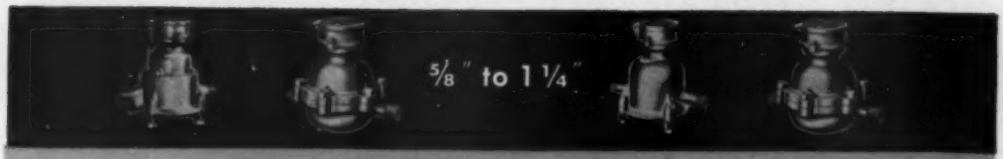
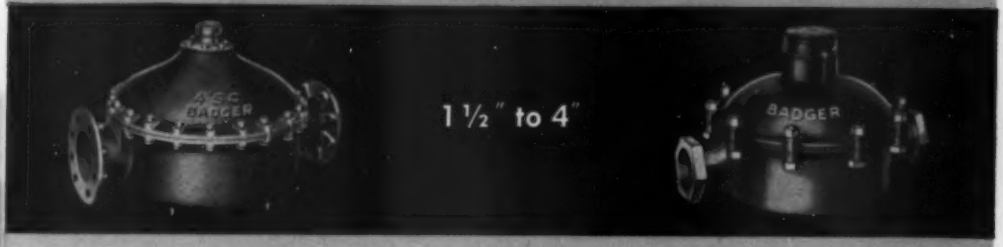


there's a RIGHT SIZE and RIGHT TYPE



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for every water meter service

Badger makes the meters you need . . . any type, any size, for any water-measuring job in home or industrial service: 5/8" to 1¼" home service meters; 2" to 12" Turbine (Current) Meters; 2" to 10" compound meters and industrial meters...of many sizes and types...also time-and-money saving accessories vital to efficient installation and servicing, including famous Badger Meter Testing Machines. For complete meter service, it pays to contact Badger.

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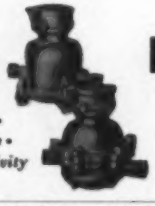
First for Accuracy • Low-Cost Maintenance • Durability • Sensitivity



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WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

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in city streets lay pipe

Known strength factors! Proved resistance to corrosion! These are your only safe and sure guides to long life and low maintenance expense of water, gas and sewer mains laid under costly modern pavements. The four strength factors that pipe must have to survive traffic shocks, heavy external loads, beam stresses and severe working pressures are listed on the page opposite. *No pipe that is deficient in any of these strength factors should ever be laid in paved streets of cities, towns and villages.* Cast iron water and gas mains, laid over a century ago, are serving in the streets of 30 or more cities in North America. These attested service records prove that cast iron pipe not only assures you of effective resistance to corrosion but all the strength factors of long life and economy, as well.

known for STRENGTH

No pipe that is deficient in any of the following strength factors should ever be laid under paved streets.

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

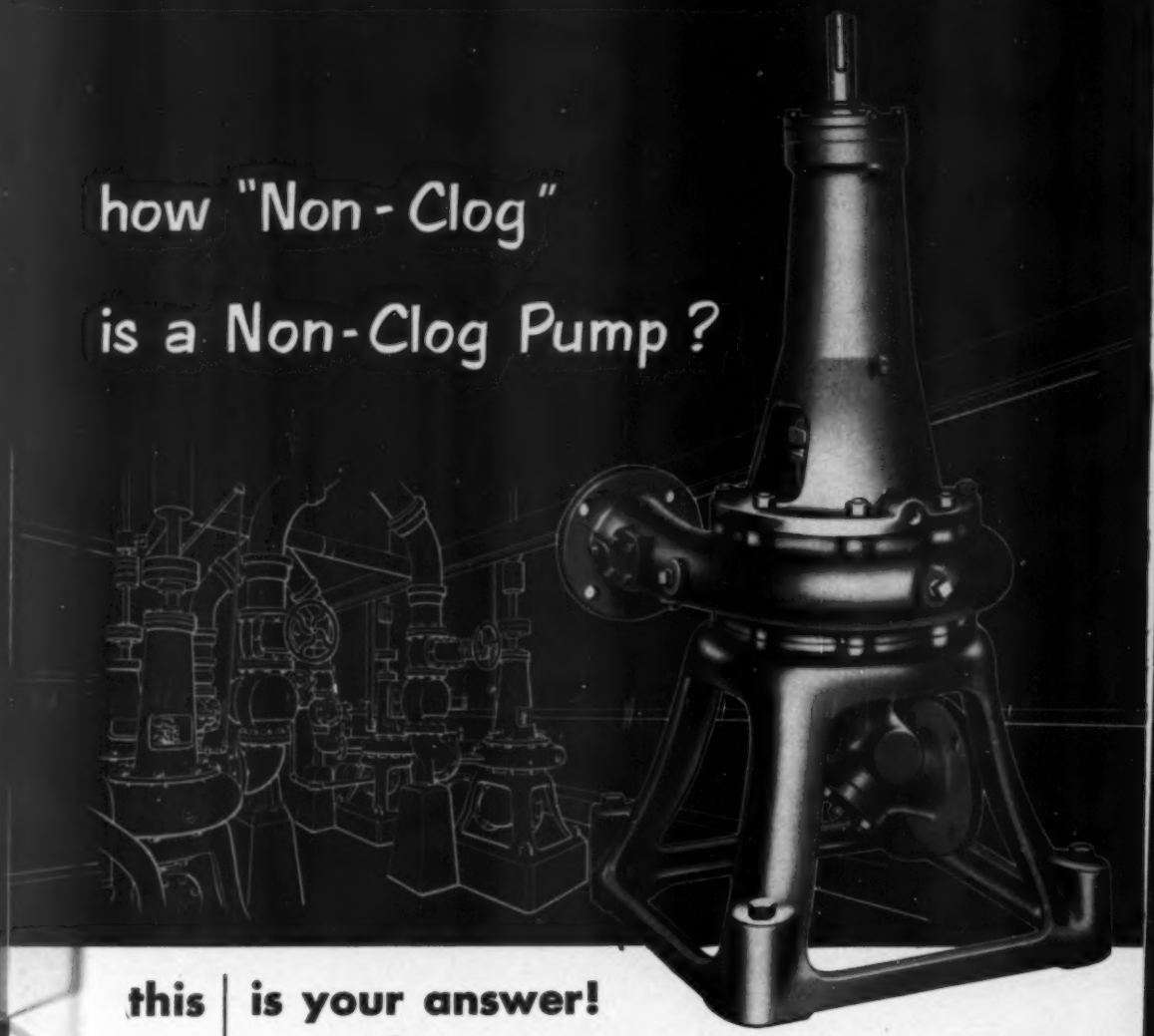
BURSTING STRENGTH

In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

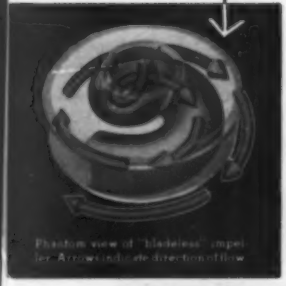
CAST IRON PIPE RESEARCH ASSOCIATION, THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

CAST IRON PIPE SERVES FOR CENTURIES

how "Non-Clog" is a Non-Clog Pump?



this is your answer!



Phantom view of "bladeless" impeller. Arrows indicate direction of flow.

Any sewage and trash pump can be clogged! But the Fairbanks-Morse *Bladeless* Impeller Pump is up to 25 times more "non-clog" than any other pump. WHY?

A sewage and trash pump clogs because fibrous trash catches on impeller blades and eventually builds up to the point where the pump "clogs." But the Fairbanks-Morse Impeller has no blades! It's a "whirling tube" with no blades or projections to catch and hold trash. In tests, even a man's complete coverall went through a 4-inch pump without clogging. In actual operation, reports prove that the Fairbanks-Morse Bladeless Impeller Pump rarely has to be dismantled to clear "clogged impellers." With previous pumps, they had to be dismantled as often as twice daily. If any pump can be called "non-clog," Fairbanks-Morse is it.

And a bonus advantage with Fairbanks-Morse: for a specific solids size, the Bladeless Impeller Pump delivers approximately 50% of the capacity of conventional sewage pumps. Thus, you do not flood filter beds in periods of low flow. This reduced capacity also permits use of smaller driving motors, assuring lower initial and operating costs.

Why not have your Fairbanks-Morse Pump Distributor or Local Branch Office give you the whole story? Or, if you prefer, write Fairbanks, Morse & Co., Chicago 5, Ill.

FAIRBANKS-MORSE,

a name worth remembering

PUMPS • SCALES • ELECTRIC MOTORS • GENERATORS • LIGHT PLANTS • DIESEL, DUAL FUEL AND GASOLINE ENGINES

TWIN WATERSPHERES PROVIDE MORE UNIFORM WATER SERVICE THROUGHOUT HOBART, INDIANA

Growing cities often find it difficult to provide satisfactory water service throughout their entire distribution systems. This is particularly true when (1) there are areas of heavy demand some distance apart or (2) when the transmission mains are inadequate to supply peak demands.

Hobart, Indiana, however, has made sure that 2,110 customers *throughout the city* will always get enough water when they need it. Twin 150,000-gallon Horton Waterspheres have been installed at widely separated locations to provide maximum efficiency in water service. In addition to furnishing dependable gravity pressure, they also assure an uninterrupted water supply in case of power failure, and a reserve immediately available for fire protection.

Many similar communities have found gravity-backed storage in Waterspheres the logical answer to better water service. They are built in standard capacities from 25,000 to 250,000 gallons. Write our nearest office for quotations or information if you are planning new storage facilities.

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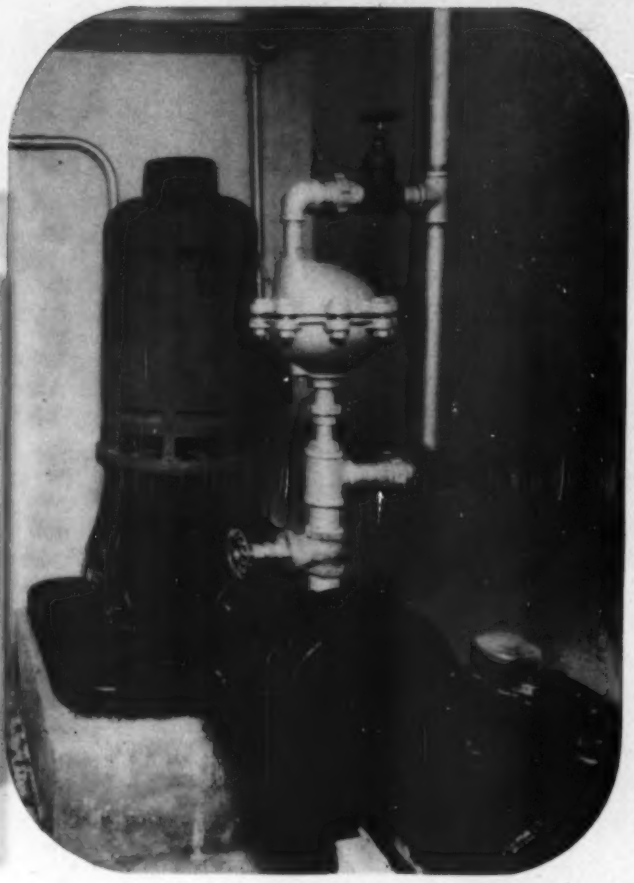
Birmingham 1	1586 North Fiftieth Street	New York 6	3390-165 Broadway Building
Boston 10	1048-201 Devonshire Street	Philadelphia 3	1644-1700 Walnut Street Building
Chicago 4	2199 McCormick Building	Salt Lake City 4	860 West 17th South Street
Cleveland 15	2262 Guildhall Building	San Francisco 11	1583-200 Bush Street
Detroit 26	1561 Lafayette Building	Seattle 1	1350 Henry Building
Havana	402 Abreu Building	Tulsa 3	1646 Hunt Building
Houston 2	2115 National Standard Building	Washington 6, D.C.	1109 Cafritz Building

42 Wells—All by Layne
SERVING WICHITA, KANSAS



The Layne pumping equipment for Wichita has made an amazingly fine record of good service. In 9 years of heavy load service, the only repairs needed was a relatively small item—6 new air lines. Well No. 1 operated day and night with no shutdown for 121 days—producing over 180,000,000 gallons of water.

THE NATION'S 2ND LARGEST MUNICIPAL USER OF GROUND WATER

In 1938, Layne installed twenty-five top performing well water units to give Wichita 48 million gallons of water daily,—enough so city officials estimated, for all needs until 1960. Then came World War II and Wichita gained many new industries and a big growth in population. The demand for water quickly became greater than the supply.

Surveys indicated that some thirty miles northwest of the city, The Equus beds offered a thousand square miles of water bearing formations. Again Layne was called in and was given a contract for seventeen new wells to be completed without delay. Layne crews swung into action. They drilled the wells, set casing, sand screen and pumps. Including testing time, a new well was completed every nine days until all seventeen were in service, increasing Wichita's total supply to 62½ million gallons per day,—more than enough for all domestic and industrial needs.

Whether for an emergency, or for normal needs, Layne is always in a position to do an outstanding job in the development of ground water for any purpose. For further information, catalogs etc., address

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VERTICAL *Turbine* PUMPS

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HOW INFILCO EQUIPMENT HELPED CLEAR LAKE, IOWA MEET ITS WATER PROBLEM

ENGINEERS: STANLEY ENGINEERING COMPANY, MUSCATINE, IOWA

Varying Raw Water Characteristics And Summer Population Increases were plaguing the City of Clear Lake, Iowa. Located on one of Iowa's outstanding blue-water lakes, the city's permanent population of 4,000 increased each summer to about 10,000. This taxed the water plant's capacity until it was operating on a direct pumping basis. Unpleasant, heavy tastes and odors of algae origin were noted during the summer. Then, occasional high winds would raise the normal turbidity of the lake from 25 ppm to 500 ppm or more.

A 1 mgd ACCELATOR® and other Infilco equipment such as dry chemical feeders, aerators, filters, and control devices solved Clear Lake's water problems. The new plant is sufficiently flexible to meet peak demands with reserve capacity. It gives Clear Lake residents *crystal clear* water that is free of odor or taste every day of every season.

Clear Lake is but one of hundreds of cities being served efficiently and economically by INFILCO Water Conditioning Equipment. Investigate how Infilco can serve you, too—whether it be modernization of an existing plant or the equipment for a new one. Write our executive offices in Tucson or call in the nearest Infilco Field Engineer. There's no obligation, of course.

SERVING MUNICIPALITIES WITH WATER CONDITIONING EQUIPMENT THAT'S

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INFILCO INC.

TUCSON, ARIZONA

WITH OFFICES IN PRINCIPAL CITIES

INFILCO

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ORLANDO, FLA.

Filtration Plant

COMPLETED IN 1949

ROBERT AND COMPANY ASSOCIATES
Architects and Engineers

The City of Orlando, Fla., is solving the taste and turbidity problems of its water supply by a two-step program, the first step of which has been completed with the construction of this new filtration and power plant. Renovation of the old *original* plant soon will complete the project. Omega Equipment selected for this fine new plant by Robert and Company Associates of Atlanta, Ga., was purchased by the Orlando Utilities Commission and installed by A. H. Guion & Co., Inc. of Charlotte, N. C., to assure clear, palatable water for the 100,000 people of Orange County. For bulletins and engineering data on Omega Feeders, address Omega Machine Co. (Division of Builders Iron Foundry), Providence 1, R. I.

Omega Equipment furnished for the new Orlando Filtration Plant:

- **6 — OMEGA Model GLW-1 Loss-In-Weight Type Gravimetric Feeders complete with Special Remote Control Panel:**
- **2 — Feeders handle Alum at rates from 5 to 500 lbs. per hr.**
- **3 — Feeders handle Hydrated Lime or Clay at rates from 2½ to 250 lbs. per hr.**
- **1 — Feeder handles Carbon at rates from 2½ to 250 lbs. per hr.**

THE LAST WORD IN FEEDERS
OMEGA

Leaks repaired three times faster with Hydrocrane

Says Water Department Spokesman

Equipped with hydraulic clamshell bucket, the water department's crane handles trenching in short order. Other attachments include crane hook, catch basin cleaning bucket, grapple, magnet and trash bucket.

Rig Enables Utility to Reduce Charges

"Water main and hydrant leaks are repaired three times faster since we use a Hydrocrane," reports Elmer L. Nordness, Asst. Supt. of the Madison, Wis. Water Dept. "An average repair took five men a whole day—now three men and a Hydrocrane do the job in less than three hours. Even in these days of rising costs we reduced water service installation charges because of the Hydrocrane's cost-cutting speed."

• Repair Men Don't Mind Look Work Now

No more heavy rubber trench boots . . . no more slippery, dangerous footing . . . no more heavy, sticky mud on shovels — a few reasons why repair men are happy since the department modernized with a Hydrocrane. Also, the crane loads directly from ditch to truck. Workmen used to shovel mud onto the street, then into trucks — a slow expensive method.

• "Telescoping Boom Sold Us"

"Often on stop valve repair or in replacing hydrants we must work next to poles and under overhanging branches," Nordness remarked. "In these spots the telescoping boom has a tremendous advantage. This feature was the real clincher that sold us on the Hydrocrane."

• Busy All The Time

The department's two cranes (they recently purchased a new H-3) are busy every day — repairing leaks . . . digging manholes, meter pits and ditches . . . loading, unloading, and setting pipe . . . handling fittings . . . and for general yard work. By using it to haul pipe carrying trailers to the job, the department eliminates an extra truck.

Two Hydrocrane sizes — ¼ yd. 2-ton; ⅜ yd. 3-ton. Send the coupon for full details.

BUCYRUS ERIE HYDROCRANE
South Milwaukee, Wisconsin

BUCYRUS-ERIE HYDROCRANE DIVISION
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Gentlemen: Tell me how the Hydrocrane can speed up my jobs.

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Company_____

Address_____

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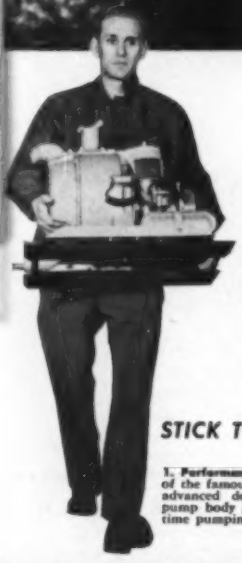

You'll never find a better pump than a

HOMELITE *Carryable* PUMP

Time is the best teacher. And the last quarter century has thoroughly proved that for easy handling, quick starting, fast priming, fast pumping and downright dependability, a Homelite Carryable Pump really tops them all. Light enough for one man to carry, a Homelite is easily put into operation any place, quickly. It is self-priming — faster than any other pump. Non-clogging. Has a 28 ft. suction lift. Automatically keeps seepage at strainer level and handles up to 15,000 gallons an hour. Send for your free copy of our latest pump bulletin.

STICK TO THE RULE OF THREE AND YOU'LL ALWAYS STICK TO A HOMELITE

1. Performance. The high, steady power of the famous Homelite engine, plus the advanced design and features of the pump body give you unsurpassed, long-time pumping performance.

2. Dependability. A Homelite Pump's dependability has been established by Homelite's quarter century experience in building more than 300,000 gasoline-engine-driven units.

3. Service. Forty-eight factory service branches located throughout the country are completely equipped and instantly ready to keep your Homelite Gasoline-Engine-Driven Pumps always in good working condition.

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BLOWERS • CHAIN SAWS

PERFORMANCE · DEPENDABILITY · SERVICE

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6. Density of Cl_2

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Division of Neptune Meter Company

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"Never again," said this bright, young water works operator. "From now on, I'm keeping a reserve stock of Aqua Nuchar Activated Carbon on hand just in case a sudden taste or odor develops in our raw water supply."

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To Prevent Hammer or Shock
the Oldest Existing White Settlement
in the New World uses

Golden-Anderson Cushioned Swing Check Valves

Ciudad Trujillo, the capital of the Dominican Republic in the West Indies, is the oldest existing settlement of white men in the New World. Discovered by Columbus on his first voyage in 1492, Ciudad Trujillo, formerly called "Santo Domingo", was founded in 1496 and is probably the most perfect "New World" example of a Spanish colonial town of the 16th Century.

This oldest settlement's water system was modernized about a decade ago by the installation of a new booster pumping plant, using Golden-Anderson cushioned relief and check valves. These automatic valves have been in constant use since that time with no repairs or trouble of any kind. Such performance records are typical of the service Golden-Anderson cushioned valves provide wherever installed. For longer service, less maintenance and greater all-around dependability—it will pay you, too, to specify and install Golden-Anderson cushioned valves on your next water control application.

Original G-A cushioned valves being installed in the pumping plant for Ciudad Trujillo. This project was engineered, designed and supervised in construction by Krajewski-Pesant Manufacturing Corp., New York, N. Y.

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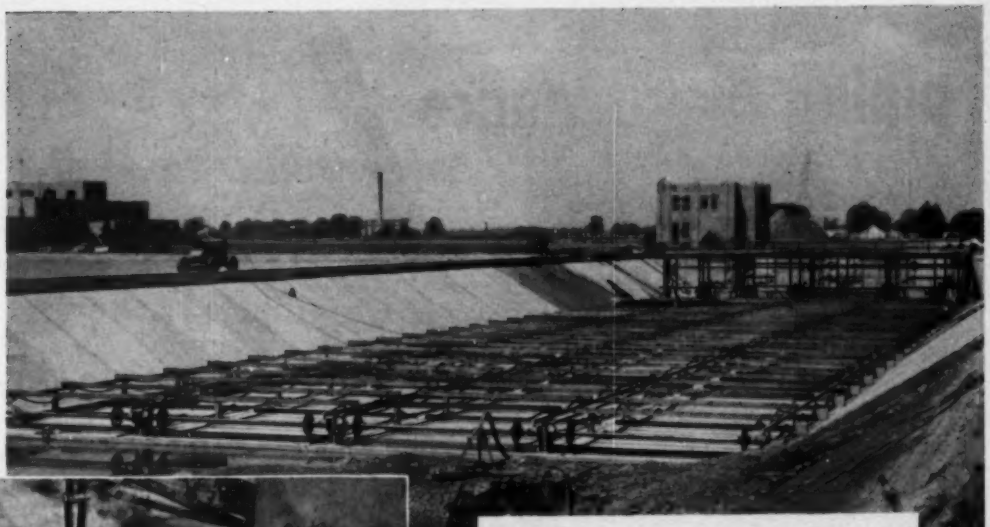

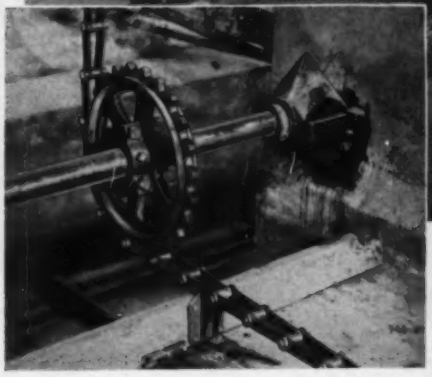

A "PERMALIFE" hunting tooth sprocket is shown in inset at left. Large view shows a group of Jeffrey Collectors all equipped with "PERMALIFE" Sprockets. Jeffrey FLOCTROLS on this job, also.

It's the SPROCKETS THAT MAKE THE DIFFERENCE

Jeffrey Sludge Collectors are different (and last longer) when equipped with our hunting tooth "PERMALIFE" Sprockets of unique design. The sprocket has an odd number of teeth (approximately 3" pitch)—one tooth moves forward at each revolution. Over any period of time the sprocket teeth get approximately one half the number of contacts with the chain barrels as in the case of regular 6" pitch sprockets.

This feature, together with Chainsaver Rims which support the side bars of the chain, WILL DOUBLE THE LIFE OF THE SPROCKETS. Investigate these IMPROVED Sprockets—made of alloy cast iron and chilled.

Send for Catalog No. 833

THE JEFFREY MANUFACTURING COMPANY Established 1877

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Complete Line of Material Handling, Processing and Mining Equipment

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CRANE VALVES

That's why more Crane Valves are used than any other make

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A typical example of low-maintenance Crane Quality—No. 465½ 125-Pound Iron Body Gates. Rarely does the bonnet joint need attention. Flange construction includes reinforcement to prevent distortion and utilizes more bolts, more closely spaced than is usual in valves of this class. Crane precision-guided seating reduces seat and disc wear. Packing has long life because these valves have a deep stuffing box filled with high grade asbestos ring packing. A ball-type gland equalizes the packing load.

Better performance features like these make Crane the better buy in valves of every type. Ask your Crane Representative for a demonstration.

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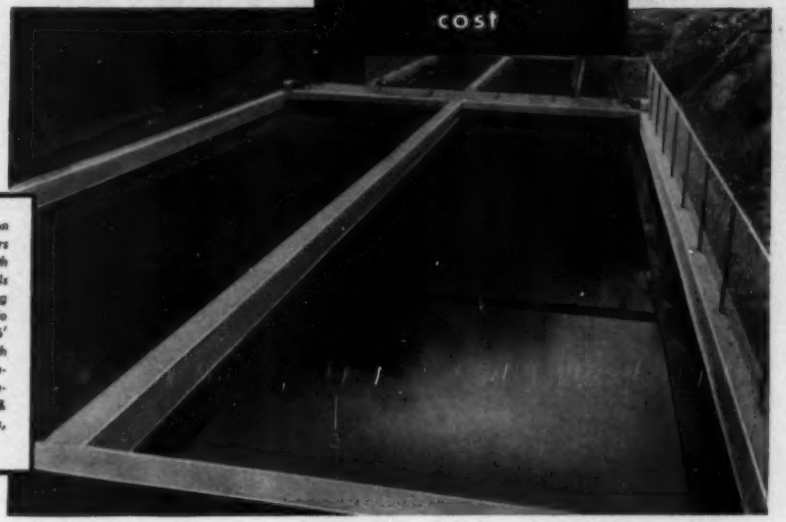

Ashland, Oregon Water Filtration Plant employing 2 Rex Flash Mixers in 6' square x 5' 2" water depth basins; 2 Rex three-stage Floctrols in 2 basins each 12' wide x 58' long x 12' water depth; 2 Rex Verti-Flo settling tanks, each 20' wide x 86' long x 14' 9" average water depth and each equipped with Rex Conveyor Sludge Collectors. Plant Capacity—6 MGD. A. D. Harvey & Associates, Consulting Engineers, Medford, Oregon.

Where you want *real* results from your water treatment plants . . . clearer effluent . . . maximum capacity at minimum cost in new or existing installations, check Rex Clarification Equipment.

REX FLASH MIXERS effect almost instantaneous dispersion of chemical throughout the water. Installed in small tanks immediately preceding flocculation tanks, they provide an exclusive double mixing action. Slow rotation is combined with fast top-to-bottom turnover for most thorough mixing. One-minute detention is usually sufficient.

REX FLOCTROLS are low in initial cost and cut chemical requirements to the minimum. They combine properly proportioned, scientifically designed paddles . . . rotating baffles . . . fixed partition walls with center ports . . . so arranged that thorough mixing is assured and short circuiting through the chamber eliminated. The resultant fast tapered mixing by zones assures large, readily settleable floc.

REX VERTI-FLO CLARIFIERS deliver a highly clarified effluent with an extremely short detention time. They consist of a series of adjustable weirs and baffles which divide a rectangular settling tank into a series of cells. Close distribution of flow among the cells is accomplished by adjusting the weirs. Large weir length and low vertical velocities assure a clearer effluent, far greater capacity . . . minimum cost.

For all the facts on these efficient units, mail the coupon.

CHAIN BELT REX COMPANY — SANITATION EQUIPMENT

CHAIN BELT COMPANY 50-205
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Milwaukee 4, Wis.

Please send me Bulletins Nos. 47-9 and 48-39

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avoid the danger of flame failure

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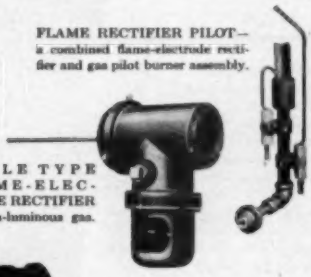
PROTECTOGLO

COMBUSTION SAFEGUARD

For Dryers, Incinerators, Boilers and Heaters

FLAME RECTIFIER PILOT—a combined flame-electrode rectifier and gas pilot burner assembly.



ANGLE TYPE FLAME-ELECTRODE RECTIFIER for non-luminous gas.

PHOTOCELL RECTIFIER—ideal detector unit for use with luminous flames.

STRAIGHT TYPE FLAME-ELECTRODE RECTIFIER for non-luminous gas.

CHECK THESE *Plus* FEATURES:

- √ "FLAME RECTIFICATION" PRINCIPLE—*Most foolproof method of flame failure protection.*
- √ POSITIVE FLAME FAILURE PROTECTION—*Flame failure automatically results in safety shut-down.*
- √ "FAIL-SAFE" OPERATION—*Automatically reacts to open, short or ground in circuit.*
- √ COMPLETE SELF-CHECKING "SAFE-START" CIRCUIT—*Automatically prevents start-up in event of electrical or mechanical failure in system.*
- √ NO EXPENSIVE SHIELDED CABLE REQUIRED—*Insulation leakage cannot "cover-up" flame failure.*
- √ PLUG-IN PURGE TIMER—*Adjustable in field from 3 to 15 minutes.*
- √ 3-SECOND TOTAL RESPONSE SPEED—*Provides full protection in flame detection.*
- √ USED WITH ANY TYPE OF FUEL—*or combination of fuels.*
- √ RUGGED UNIT CONSTRUCTION—*withstands severe industrial usage.*
- √ RELITE IS POSSIBLE WITHOUT ADDITIONAL RELAYS.
- √ FACTORY MUTUAL AND UNDERWRITERS APPROVAL.

FLAME FAILURES are no cause for concern when dryers, incinerators, boilers and heaters are equipped with Protectoglo combustion safeguards. Thousands are providing the most positive, economical insurance against the hazards of explosion in all phases of industry.

The Protectoglo affords automatic fool-proof protection. It completely eliminates all the inherent weaknesses of the "flame conductivity" principle. This is accomplished by the "flame-rectification" principle which utilizes the flame to complete the system's electronic circuit. In the event of flame failure, the circuit breaks, resulting in immediate safety shut-down. An additional safety factor is provided by an automatic shut-down in the event of an electrical or mechanical failure in the relay. Versatility of application is afforded by the four different flame detector units.

Check the plus features of this aid to combustion safety . . . write for Catalog 9601. Your local Honeywell engineer will be glad to discuss your problems and furnish constructive help. Call him today.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4575 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

HOW CLEVELAND LICKED...

ONE OF ITS *Toughest* SEWER PROBLEMS

The sewer at Edgewater Park ran right along the filled-in shore of Lake Erie. Half of the 910' line lay well below the lake level. But infiltration from Lake Erie was only part of the problem. The big danger was waste acids from nearby rayon plants . . . waste acids that had destroyed the previous line and would eat out ordinary concrete pipe almost as fast as it could be laid.

Cleveland City Engineers had specified Hamilton Kent's Tylox rubber gaskets for they knew if anything would hold out the waters of Lake Erie it would be Tylox, the rubber gasket that has earned the reputation of being "leakproof for the life of the line."

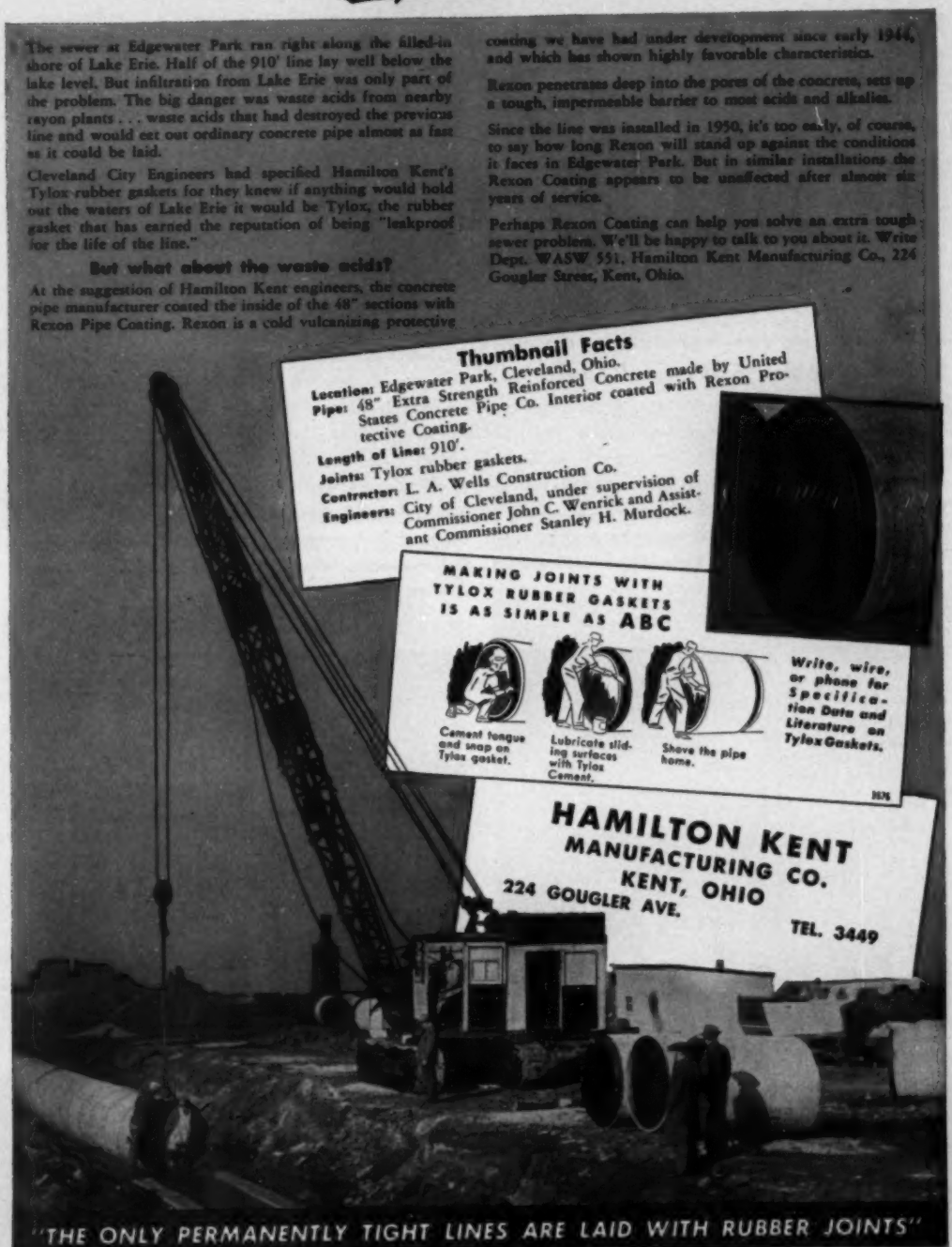
But what about the waste acids?

At the suggestion of Hamilton Kent engineers, the concrete pipe manufacturer coated the inside of the 48" sections with Rexon Pipe Coating. Rexon is a cold vulcanizing protective coating we have had under development since early 1944, and which has shown highly favorable characteristics.

Rexon penetrates deep into the pores of the concrete, sets up a tough, impermeable barrier to most acids and alkalies.

Since the line was installed in 1950, it's too early, of course, to say how long Rexon will stand up against the conditions it faces in Edgewater Park. But in similar installations the Rexon Coating appears to be unaffected after almost six years of service.

Perhaps Rexon Coating can help you solve an extra tough sewer problem. We'll be happy to talk to you about it. Write Dept. WASW 551, Hamilton Kent Manufacturing Co., 224 Gougler Street, Kent, Ohio.


Thumbnail Facts
Location: Edgewater Park, Cleveland, Ohio.
Pipe: 48" Extra Strength Reinforced Concrete made by United States Concrete Pipe Co. Interior coated with Rexon Protective Coating.
Length of Line: 910'.
Joints: Tylox rubber gaskets.
Contractor: L. A. Wells Construction Co.
Engineers: City of Cleveland, under supervision of Commissioner John C. Wenrick and Assistant Commissioner Stanley H. Murdock.
MAKING JOINTS WITH TYLOX RUBBER GASKETS IS AS SIMPLE AS ABC
Cement tongue and snap on Tylox gasket.
Lubricate sliding surfaces with Tylox Cement.
Shove the pipe home.
Write, wire, or phone for Specification Data and Literature on Tylox Gaskets.
HKM
HAMILTON KENT MANUFACTURING CO.
KENT, OHIO
224 GOUGLER AVE.
TEL. 3449
"THE ONLY PERMANENTLY TIGHT LINES ARE LAID WITH RUBBER JOINTS"

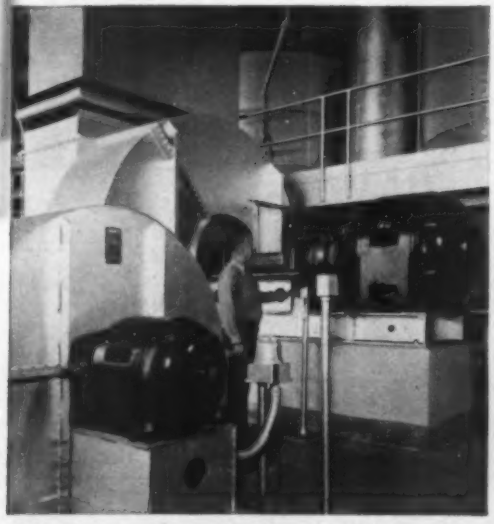
HYPERION BRINGS CLEAN WATERS TO LOS ANGELES

G-E equipment plays vital role in one of world's largest sewage treatment plants, due for 1951 completion

Hyperion Sewage Treatment Plant at El Segundo, California will serve the entire Los Angeles area. The $42,000,000 installation will be almost completely self-sufficient; it will generate all the power and produce nearly all the fuel required for its operation.

General Electric application engineers, working with contractors and architects, have fitted G-E motors and control components to many of the plant's intricate operations. Pictured on these two pages are some of the applications of General Electric equipment that will help reduce Los Angeles' raw sewage discharge into the ocean to a standby disposal.

General Electric helps you in (1) winning public support with the complete G-E packaged program "Modern Sewage Treatment" including the full-color sound movie *Clean Waters,* and (2) by assisting in the formulation of electrical plans. Help make your pollution-control program a success by contacting your G-E representative early in the planning stage. ***General Electric Company, Schenectady 5, N. Y.***



A plant foreman starts one of the G-E 250-hp motors that drives a vapor fan. In the foreground is 30-hp General Electric motor driving combustion air fan. All motors in the plant were selected by G-E engineers to fit the particular application.

The intricate sludge conveyor system is powered by G-E Tri-Clad* gear-motors, shown here ready to go into operation. Their attractive appearance is backed by cast-iron construction for corrosion resistance.

* *Registered Trade-mark of General Electric Co.*

Hyperion Sewage Treatment Plant covers 76 acres of reclaimed land near Santa Monica Bay, about 15 miles from downtown Los Angeles. The opening of the last unit in 1951 will climax ten years of planning and construction.

G-E fractional-horsepower motors drive the longitudinal collectors in the plant's primary settling tanks. These small, tough motors must give dependable day-in, day-out service regardless of any extremes of weather.

During installation of the equipment, the G-E hook-on voltammeter was used extensively. With it the operator can determine whether motors are drawing excess current plus numerous other jobs around the plant.

GENERAL ELECTRIC

TRIDENT METERS

never become OBSOLETE

because Trident Meters have always been made on the principle of

Interchangeability

Lack of Meter Depreciation Astounds Water Rate Probers

Depreciation, bugaboo of industry, is not part of a water meter expert's worries.

There is no such thing, said the New York meter expert who was summoned by Rochester and Lake Ontario Water Service Corporation to appear before the Public Service Commission.

The commission, investigating the rates charged by the company, was mystified by the company's statement that water meters did not depreciate.

Almost unheard of they said.

So up from New York came the expert who backed up the company in every detail. He took a meter apart under the eyes of the commission and explained its workings. A meter manufactured in 1898, he said, is repaired with parts manufactured today.

Not only is there no depreciation, but there is scarcely any change in design. So he took an old meter, fitted in new parts, and it worked perfectly.

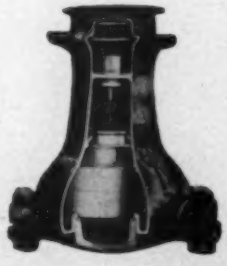
Under PSC regulations the company must test its meters every five years. The company more than complies with these rules, officials said.

Rochester "Democrat and Chronicle"

Here is PROOF of what experienced Water Works operators know so well — that new IMPROVED Trident parts fit easily and perfectly into Tridents even 50 years old making them even better than when new. So no standard Trident Meter need ever be retired through lack of replacement parts. Therefore, Trident Meters do not depreciate and will never become obsolete.

An 1898 Trident Meter Made BETTER *Than New!*

You see here what the expert demonstrated . . . how Neptune's basic policy of interchangeability provides standard modern Trident parts that fit perfectly into old Trident casings.



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Branch Offices in Atlanta, Boston, Chicago, Dallas, Denver, Los Angeles, Louisville, North Kansas City, Portland, Ore., San Francisco.

NEPTUNE METERS, LTD., Long Branch, Ont., Canada

WATER & SEWAGE WORKS

VOL. 98, NO. 5 • A GILLETTE PUBLICATION • MAY 1951

The Water Division's Fleet of 18 Radio Equipped Trucks
(New Garage and 100 Ft. Radio Transmitting Tower Beyond.)

Radio Control-Kardex Record System Combination

Comprises Development Representing Marked Progress in Water Works Operation, Maintenance and Repair at Winnipeg.

by W. L. WARDROP, *Engineer of Water & Sewage Works, Winnipeg, Manitoba, Canada.*

DURING the early part of 1950 the Department of Transport, Canada, granted the Water Works Operating Division their own radio frequency. Prior to that time, the Water Works Division operated on the same frequency as the City of Winnipeg Fire Department. Each department had its own central station and these stations were located approximately two miles apart. As can be readily appreciated, there was considerable interference, particularly during the time of a fire when, in most cases, it was necessary for our Water Works stations to stand by. The change over to separate frequency operation was set for May 1st, 1950. However, as a result of the Red River Valley Flood, it was delayed until July 28th, 1950—a date which marked a very important change in the Department's communication system.

It is at a time of an emergency that the full significance of good communications is realized. Although few cities will experience the emergency that faced the citizens of Winnipeg during the spring of 1950, communications played a very important part in that heroic battle against the flood waters of the Red River. One of the most important features essential to a good communication system is dependability and this assumes its full degree of importance at the time of an emergency. Two factors contributing to the dependability of a communication system are standby equipment and, most important, a standby power supply. Both of these components were provided for in the former system by interconnecting the two central stations in such a manner that either station could be operated from either location. This arrangement, of course, was only possible so long as both transmitters were operating on the same frequency. As the source of power for each of these central stations was taken from different power districts, the system was reasonably well protected against a power failure. Under the new arrangement, it was necessary to provide an additional transmitter for standby and also some form of auxiliary power. A 3 kilowatt Kohler Electric Plant (Model 3A21) was chosen as an alternate power supply.

Radio Control and Record Room

Photograph—2 shows part of the Radio Control and Record Room which is located centrally in the Administrative Offices of the Water Works Operating Division at Ross Avenue and Tecumseh Street. Of the two transmitters in the rear, on the left is the original transmitter, obtained from the Canadian Marconi Company in 1946. It is now used as a standby. On the right is the new transmitter, also obtained from the Canadian Marconi Company. On the extreme right is the two position operator's desk with control console at centre. The operator's desk, including the console cabinet, was custom built by a local wood working firm. Mr. C. E. Tremblay, Sales Engineer with the Canadian Marconi Company designed the control console which was made up in their Winnipeg shop. The control console is equipped with a direct reading electric clock, a thirteen station intercommunication unit, controls for remote operation of the transmitter and receiver, change switch for selecting No. 1 or No. 2 transmitter, control switches for main and auxiliary power, fuel gauge and various indicator lights.

Located in two rows across the top of the control console are forty amber and forty white station indicator lights. These are controlled by four banks of ten single pole double throw switches located on the desk in front of the console within easy reach of either operator. The switches were arranged in rows of ten to simplify the selection of any desired station. The amber lights provide an indication of the mobile stations on the air, while the white lights indicate the stations that report off the air at a location. For example, a meter-turnkey reports off the air for the interval that he is in a building changing a meter. Exhibit—1 shows the Daily Location Log maintained by the central station clerks to record the locations of the various trucks while they are off the air. Let us assume that at 09:30

The Winnipeg Water Works was one of the first water utilities to use radio communications.

In 1934, a one-way radio link was provided between the Water Works Emergency Truck and the Winnipeg Police Department. This was changed to a two-way system in 1939.

Early in 1946 the Water Works Division installed its own two-way F.M. Radio System, operating on the same frequency as the Winnipeg Fire Department.

In 1950, the Water Works Division was granted its own separate frequency, and the Kardex Record, covering approximately 55,000 services, was completed and incorporated in a new Radio Control and Record Room. At the present time, another Kardex System is being developed to cover water main, hydrant and valve records. These developments represent noteworthy progress in the Water Works Operating Division of the Engineering Department of the City of Winnipeg.

Photo. No. 2—Section of Radio Control and Record Room
Centrally located in Administrative Offices. Control Room Clerk on duty is "Bill" Ingimundarson.

hours, Mobile Station No. 4 reports "Off the air, 50 minutes at 100 Princess Street," the clerk records under No. 4, 09:30 in the "time off" space; 50 in the "duration" space; 100 Princess Street in the column for locations; inserts the location reference number in the "location" space under No. 4 and switches No. 4 light to white. When No. 4 returns to the air, the clerk records the time in the "time on" space and changes No. 4 light back to amber. This record is of particular importance in meter-turnkey work as it provides the Foreman with the location of the meter-turnkeys so that, in case an emergency arises, he can contact them immediately by telephone.

The station indicator lights are arranged numerically and correspond to the vehicle numbers. Nos. 1 to 25 are allotted for Water Works vehicles; Nos. 31 to 40 for the Engineering Department vehicles; and Nos. 91 to 95 for the Sewer Maintenance vehicles. At the present time, there is a total of 28 stations operating on the system made up as follows: Water Works Division (18), Engineering Department (7), Sewer Maintenance Division (3). There are also indicator lights on the console to show the operator which transmitter is being used, whether the system is operating on main or auxiliary power or whether the transmitter or intercommunication system is busy. The panel of the control console is hinged at the top and provides easy access for maintenance. Power supplies for the various control equipment are located inside of the control console.

A remote control unit is located in the offices of both the City Engineer and the Engineer of Water Works & Sewerage. These units can also be used to provide intercommunication between these offices as well as operating the transmitter and receiver. During the flood emergency, similar remote control units were installed at Flood Control Headquarters and the residence of City Engineer, W. D. Hurst. The use of these units greatly enhanced the flexibility of the radio system during that crisis. A switch located on the control console disconnects the remote control lines in the event that line trouble is encountered. An auxiliary microphone position has also been provided in case the remote control equipment fails.

The personnel in the Radio Control and Record Room consists of a Radio Clerk and a Kardex System Clerk. The Kardex Clerk maintains the service records and assists the Radio Clerk during busy periods. "Turn On" and "Turn Off" orders are also handled by these clerks. Note the convenient location for the telephone with the telephone selector switches located on the desk directly above the station indicator light switches. All four telephone lines come into the control room so that outside of office hours the Night-Clerk can answer all calls conveniently, each line having its own distinguishing ring.

The control room clerk has direct communication with the following offices through the intercommunication system: Engineer of Water Works &

Photo. No. 3—Section of Radio Control and Record Room
Showing Kardex Record Files and Control Room Clerk "Bob" Fergusson on duty.

CITY OF WINNIPEG – ENGINEERING DEPARTMENT
WATER WORKS & SEWERAGE BRANCH
RADIO COMMUNICATION SYSTEM.

DAILY LOCATION RECORD

SHEET NO. 1
DATE MARCH 31 - 1951

MOBILE STATION No.	WATERWORKS																									ENGINEERS						SEWER MAINTENANCE				LOCATIONS			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	01	02	03	04				
TIME OFF				0930																															1	100 PRINCESS ST.	51	
DURATION LOCATION				1																															2		52	
TIME ON				1020																															3		53	
TIME OFF																																			4		54	
DURATION LOCATION																																			5		55	
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DURATION LOCATION																																			47		98	
TIME ON																																			48		99	
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																																			50			

OPERATOR _____

Exhibit 1—Daily Location Log Used to Record "Off the Air" Locations of Various Mobile Units

Photo. No. 4—All important Stand-by Power Unit
Generates 110 V.—A.C. to provide emergency power for radio operation and Control Room lighting.

Sewerage, Assistant Engineer, Chief Clerk, Meter Section, Garage, Stores, Equipment Repair, Machine Shop, Sewer Maintenance Division and Lunch-Room.

It can be readily realized that the control room is the nerve centre of the communication system. Unfortunately, the complete system was not in operation during the flood emergency. The intercommunication equipment was only partially installed. However, emergency lines to four of the important offices allowed us to take advantage of part of this equipment at that time. The Fire Department co-operated by using the radio system as little as possible.

The Control Room During the 1950 Flood

The control room during the 1950 flood was one of the busiest locations, for it was at this point that an unbelievable number of messages were handled. Every available radio equipped vehicle was used to provide communication links to the various dike areas and supply points. The control room clerks, who worked on 12-hour shifts during the crisis, established themselves as outstanding operators. They are deserving of much credit for the splendid communications that were provided by the Department during the flood emergency. Those who are familiar with radio communications will appreciate the task that faced the control operators when it is considered that as many as twenty-two mobile units worked to this control station. Requests for sand, sand-bags, earth fill, pumps, lighting equipment, fuel, personnel, reports of dike conditions, etc., kept the system in constant use. Sometimes, we wonder what the situation might have been without radio communication—for it was a battle waged on a wide front and radio with its mobility proved all important.

The Auxiliary Power Supply

So important was the question of auxiliary power supply that the Electric Standby Unit, then on order, was brought by air from Kohler, Wisconsin, and installed temporarily. Fortunately, the main power did not fail, although the City Hydro's Rover Avenue terminal station and the Winnipeg Electric Company's Mill Street terminal station were seriously threatened. The auxiliary Electric Standby Unit has since been permanently installed. This unit starts automatically as soon as a line load is applied and stops when the load is removed. Tests have indicated that its regulation is very satisfactory and noise interference negligible. The change over from main to auxiliary power is accomplished through a magnetic transfer switch remotely controlled from the control console. Photograph—4 shows the 110 volt standby installation located in the Administrative

Photo. No. 5—Control Room Clerk at Kardex Files
"Mike" with extending cord permits conversation with mobile units while transmitting information direct from file cards and while moving from place to place.

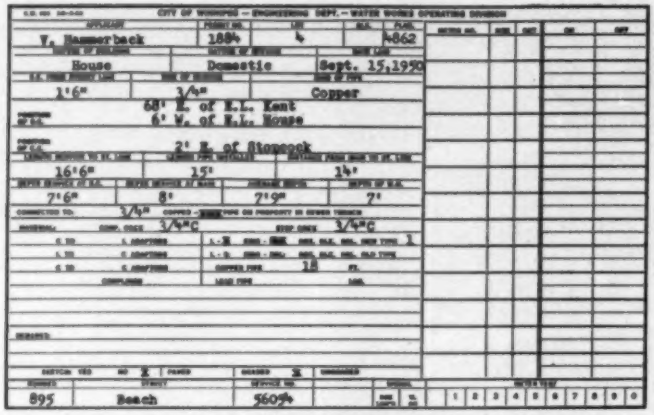

Exhibit 2—Water Service Record Card

From Kardex Record Files Covering Better Than 55,000 Services.

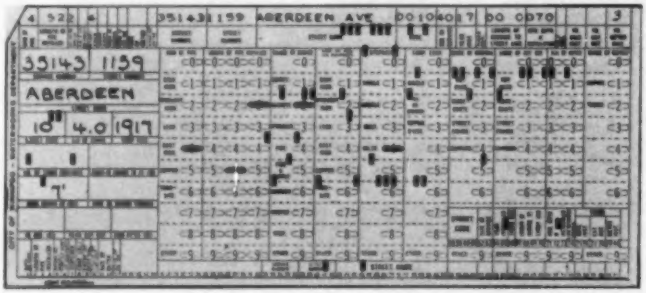

Exhibit 3—Mark-Sensing Card

Used to supply key information on water services to the I.B.M. Punch Card Accounting System.

Building approximately 100 feet from the control room. A 55 U.S. gallon fuel tank is located in a concrete pit outside of the building and is equipped with a fuel gauge which indicates on the control console. The power supply for the intercommunication system and the Control and Record Room lighting are both on the standby circuit. Normal routine includes one hour operation each week on standby power to ensure that the equipment is operative.

We, in Winnipeg, are very proud of our communication system. Proud of it because we feel that it allows the Department to provide better service to the citizens of Winnipeg. It enables our maintenance crews to obtain information quickly. Emergency crews can be dispatched at a moment's notice with the minimum of delay. It has become an essential part of our Water Works System. Photograph —1 shows our fleet of trucks, the majority of which, are radio equipped. The two panel delivery vehicles on the right were added in 1949 and are used by the Foreman of Mains and the Foreman of Services for supervision of the field crews. The fleet colour is mission yellow with black lettering. The Water Works Garage in the background was built in 1948 and provides storage facilities for the motor equipment. The 100-foot transmission tower at the centre is part of the central station equipment and is located at one end of the Administrative Office Building.

The Water Service Record

An integral part of the Radio Control Room is the Kardex Record System consisting of over 55,000 service cards. Note in Photograph—3 that the Kardex cabinets are located with a view to being readily accessible to the clerks. This project required over three years to complete and now provides a flexible, comprehensive service record. To further facilitate the providing of service information over the radio system, two microphones with extending cords are located at convenient points along the Kardex cabinets. This eliminates the necessity of the clerk moving back and forth between the record files and the control desk. Photograph—5 shows a control room clerk using one of the microphones to give information over the radio system. An 8 in. speaker and baffle, located near the ceiling, provides excellent voice reproduction throughout the room. The control room is sufficiently sound proof that it does not interfere with the general office.

The service records are maintained on different coloured cards corresponding to the size of the service with all pertinent information about the service recorded on the face of the card. "Turn On" and "Turn Off" orders are also recorded on the face of the card, together with a record of the meter removals. The reverse side of the card is used for a sketch where required and the recording of service repairs. Exhibit—2 shows a standard 5" x 8" Kardex card as used for the service record. The use of coloured tabs in the signal area to indicate whether the water has been turned off, whether the water is on for building construction, or whether the stop cock box is lowered below the side walk (service no longer in use) has proved very satisfactory. The absence of a coloured tab in the signal area indicates that the water is on permanently. Coloured tabs are also used in the area marked "Meter Test" to indicate the size of meter installed and the numbers 1 to 10 are used to indicate the year the meter is to be removed for routine test. The advantage of using coloured tabs is that they provide, at a glance, certain pertinent information.

Vital information about the services is also maintained on an I. B. M. (International Business Machines) Punch Card Accounting System which can be used to provide complete statistical data when required. This information is supplied to the I.B.M. through a mark-sensing card as shown in Exhibit—3. It is a dual purpose card and is divided into three parts: a written area at the left; a mark-sensing area at the right; and an interpretation area along the top. The mark-sensed information is recorded on the card by pencilling in designated fields as shown in the exhibit. The cards are then forwarded to the I.B.M. local office where they are processed for punch marking and interpretation. The completed card is then retained on file, in numerical order by service number and can be used to provide statistical data when required. As these cards constitute a permanent duplicate record of water services, they will be retained in a location other than the Water Works Administrative Office Building as a safety measure.

The information in the mark-sensed area is punched into the card automatically as the pencilled fields pass over a series of mark-sensing reading brushes. The graphite in the pencilled fields complete electric circuits which in turn operate the punching units. The information in the area at the left is punched into the card manually. The punched information is read by an interpreting machine which prints the information along the top of the card in code form.

Proposed Record for Mains, Hydrants, Valves

At the present time, we are in the process of developing a Kardex record to cover all water mains, hydrants and valves. When this has been completed, all of our distribution system records will have been centralized so that they will be readily available on a moment's notice to all concerned through our extensive communication system.

The water main record will consist of approximately 5,000 cards arranged alphabetically by street blocks. As with the service record, different coloured cards will correspond to the different sizes of water mains. The longest block in Winnipeg is approximately 1,200 feet so that this length has been selected as a maximum to be placed on each card. Some cards may, therefore, contain two or possibly three of the smaller blocks. The card, shown as Exhibit—4, has been developed with a view to providing a visual indication of the condition of the water main. Soil conditions in the Winnipeg area are so severe, both with respect to chemical and physical properties, that maintenance work on the distribution system is relatively heavy. About two-thirds of the Winnipeg water distribution system was installed during the period 1900 to 1912. Our experience with corrosion and graphitization indicates that the life of cast-iron water mains in the Winnipeg area is approximately fifty years. The system, therefore, is approaching the age when the replacement program is becoming of major concern. Such a program can only be based on the actual condition of the pipe. The comprehensive maintenance record under development will facilitate the planning of renewal programs.

Rating Condition of Mains

In making a preliminary analysis of the distribution system for the purpose of establishing a sound water main replacement program, it was considered that maintenance over the last ten-year period would provide a suitable basis. In order to provide a common reference for comparing the relative condition of various water mains, it was decided to use the factor "leaks per mile per year" over the last ten-year period. For example, let us suppose that during the last ten years, 30 breaks occurred on a section of water main 600 feet in length. The "leaks per mile per year" factor would be $30 \times 5280 \div 600 \times 10 = 26.4$. If only 3 breaks had occured on this section during the past ten years the factor would have been 2.64. A coloured tab in the "leak per mile per year" signal area will, therefore, provide an indication of whether a particular section of water main has required relatively heavy maintenance over the last ten-year period. A different colour of tab will be used to indicate whether the "leak per mile per year" factor is between 0 and 5, 5 and 10, or 10 and 15, etc. It is fully appreciated that there are many other factors and questions to be considered such as—"Are the breaks the result of pipe corrosion; cracked pipe, due to excess stresses; or, are they due to other causes? Are the repairs costly? Are the repairs at locations where considerable inconvenience is caused to the customers? Are the repairs in a district where temporary supplies will be required?" All of these questions must be given careful consideration before a water main is placed on the renewal list. The "leak per mile per year" signal indication will forewarn that a particular section of water main requires investigation.

The number of water main breaks occurring during the current year are

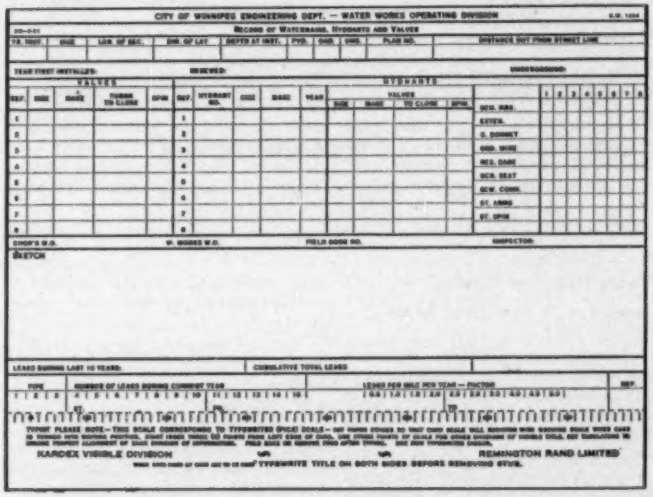

Exhibit 4—Water Main, Hydrant and Valve Record Card for Kardex System

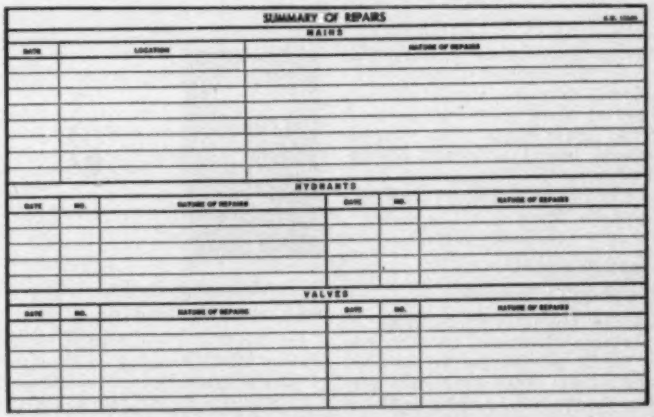

Exhibit 5—Reverse Side of Above Card

Hereon records of repairs to mains, valves and hydrants will be kept up to date.

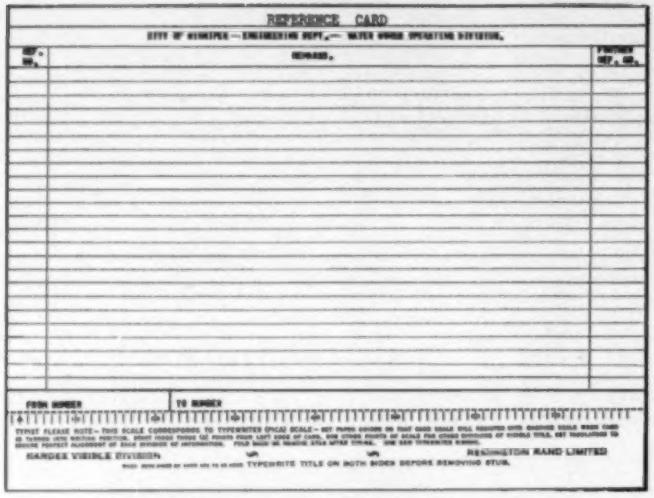

Exhibit 6—Proposed Note Reference Card

To be used for special notes to supplement information on previously shown cards.

also indicated on the proposed card by a visual signal. Exhibit—5 is the reverse side of the card (Exhibit—4) to be used to record water main repairs, hydrant and valve repairs. An insert card can be added to provide additional space for recording repairs. There is certain explanatory information which it would not be practical to provide space for on the water main record card. Exhibit—6 shows the Note Reference Card, which will form part of the proposed record system. These cards will be placed in the Kardex system for easy reference. The notes will be entered in numerical order and space has been provided on the water main record card for the note reference number.

As with the service record, vital information about the water mains, hydrants and valves, will also be placed on the I.B.M. Punch Card Accounting System. In this way, statistical data for analyzing the distribution system will be readily available when required.

A great amount of thought has been given to the development of comprehensive records for the Winnipeg Water Distribution System. It is felt that both the present service record and the proposed water main record will meet requirements for many years to come. The Kardex System is flexible and most convenient. Coupled with an effective communication system, we believe it provides a combination unparalleled in the water utility field.

Water Pollution Control

Excerpts from "A Water Policy for the American People"

The Division of Water Pollution Control of the U. S. Public Health Service has wisely reprinted excerpts for the "Report of the President's Water Resources Policy Commission." Under the title, "Water Pollution Control," these Excerpts cover the Committee's Report on Pollution Control, Domestic and Industrial Water Supply, and excerpts from other chapters.

If you didn't see a copy of that outstanding document on "A Water Policy for the American People" in its entirety, then you should obtain a copy of these pertinent excerpts. Write Mark Hollis, Asst. Surgeon General, U.S. Pub. Health Service, Washington 25, D.C. and ask for a copy of Public Health Service Publication No. 58.

Clean Water Is Everybody's Business

Under the title "Clean Water Is Everybody's Business," the U.S. Public Health Service has issued a 30 page bulletin which graphically presents the problem of stream pollution in the United States. This is an excellent piece of material for those persons confronted with the problem of selling sewage or industrial waste treatment in their communities.

The bulletin gives several case histories, and shows what steps should be taken to solve the problems in definite situations.

Copies of "Clean Water Is Everybody's Business" may be obtained for 20 cents each by writing the Supt. of Documents, U.S. Govt. Printing Office, Washington 25, D.C. Ask for Public Health Service Publication No. 11.

R. E. McDonnell Retires As Consulting Engineer

On April 2, the fifty-third anniversary of the founding of the firm of Burns & McDonnell in Kansas City, Mr. R. E. McDonnell retired from active participation in the affairs of the company.

The firm issued a very attractive brochure showing the wide distribution of works which the firm has designed under Mr. McDonnell's direction, and telling about the present personnel of the organization.

The founder's retirement was commemorated further on April 3 at a dinner party at the Saddle and Sirloin Club in Kansas City. At that time a plaque was presented to Mr. McDonnell by the entire organization of the company. The inscription read as follows:

"In commemoration of his fifty-three years of outstanding engineering achievement and leadership, and as an expression of respect, admiration, and heartfelt affection of his associates and co-workers in the firm which he founded April 1, 1898. Presented on the occasion of his retirement."

Fleas—And No Red-heads!

A dog sees everything as pale gray. There are no known brown, red, blue, or white details in his world. An Irish setter is not a red-haired beauty to another dog; it's just another gray member of the race.

Now we know the meaning of "a dog's life."—No Red-Heads!

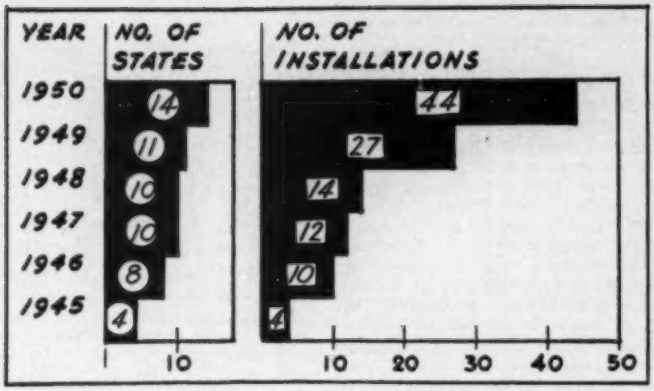

Fig. 1—Fluoridation Developments in 1945 to 1950

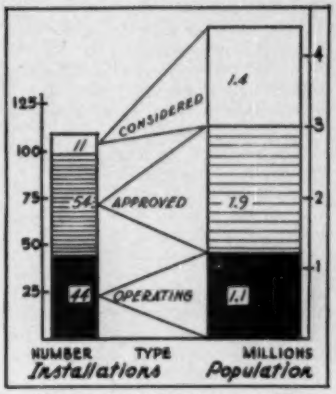

Fig. 2—Fluoridation Status in 1950

Developments in Fluoridation—
A Summary*

by HARRY A. FABER, *Research Chemist, The Chlorine Institute, Inc., New York, N. Y.*

FIVE years have passed since the inception of fluoridation in the treatment of public water supplies. The practice was undertaken as an experimental study to determine the relation of this supplemental treatment to the incidence of dental caries. In the present stage of the experiment, a summary of developments in fluoridation can best be presented as a progress report.

The fluoridation of water represents a significant large scale study in public health. It was inaugurated with the operation of four experimental installations in 1945. These experimental installations have increased in number to 14 in 1950. *Experimental* installations are those in which fluoride† is applied to water under controlled conditions with the concurrent use of scientific methods to test the fluoride-caries relationship.

Rather than awaiting the evidence which will be provided by the results of experimental studies underway, other installations of fluoridation have been made on an empirical basis. The number of empirical installations has grown from two in 1946 to at least 30 in 1950. *Empirical* installations are those in which fluoride† is applied to water under controlled conditions without the concurrent use of scientific methods to test the fluoride-caries relationship.

The developing interest in fluoridation is further indicated by the fact that, during 1950, at least 54 additional installations received the approval of State Departments of Health. Finally, fluoridation was reported to be under consideration by 11 more communities—and this number probably had increased by the end of 1950.

Table 1
FLUORIDATION
Experimental Installations Operating

State	Community
Connecticut	Southbury (Institution)
Delaware	Newark
Illinois	Evanston
Kansas	Ottawa
Massachusetts	Belchertown (Institution)
	Wrentham (Institution)
Michigan	Grand Rapids
New York	Newburgh
N. Carolina	Charlotte
Texas	Marshall
Wisconsin	Madison
	Oshkosh
	Rhinelander
Ontario, Can.	Brantford
(Total = 11)	(Total = 14)

These data are quoted from a compilation of reports prepared by Z. M. Stadt[1], in October, 1950. The locations of experimental and empirical fluoridation installations are listed in Tables 1 and 2. The locations of fluoridation installations which have been approved and which are under consideration are listed in Tables 3 and 4.

The development of fluoridation by states and by installations for the pe-

Table 2
FLUORIDATION
Empirical Installations Operating

State	Community
Florida	Gainesville
Idaho	Lewiston
Michigan	Midland
	Algonac
	Ludington
New Jersey	Morristown
Texas	Corpus Christi
Wisconsin	Sheboygan
	Elkhorn
	Janesville
	Beloit
	Mukwonago
	Baraboo
	Antigo
	Stoughton
	Ashland
	Edgar
	Richland Center
	Soldier's Grove
	Hartford
	Oregon
	Reedsburg
	Mayville
	Racine
	Sun Prairie
	Evansville
	Neenah
	Middleton
	Stevens Point
	Bloomer
(Total = 6)	(Total = 30)

*Presented at the Third Inservice Training Course in Water Works Problems, University of Michigan, School of Public Health, February, 1951. Published here by permission.

†Throughout this article the word "fluoride" signifies fluoride ion or fluoride salt as the text connotation indicates.

riod 1945 to 1950 is illustrated in Fig. 1. The status of fluoridation in 1950 is presented graphically in Fig. 2, which relates the number and type of installations to the population served. These figures have been developed from Stadt's data.

The chemical treatment of water for physiological benefits is thoroughly and thoughtfully evaluated by C. R. Cox in the new A.W.W.A. *Manual of Water Quality and Treatment*[3]. It is emphasized that the concentration of fluoride ion is generally maintained at 1.0 to 1.2 ppm.—well within the U. S. Public Health Service *Drinking Water Standards*' specification of a permissible maximum of 1.5 ppm. fluoride content.

The general public is justifiably interested in the potentialities of fluoridation. Its interest is immeasurably greater than that shown in any previous water treatment practice. This popular appeal accounts in large measure for the rapid expansion of fluoridation installations.

The practice of fluoridation, however, constitutes a new role for water treatment. It involves not only the investigation of technical problems,

Table 3
FLUORIDATION
Installations Approved

State	Community		
Connecticut	New Britain		
	Bristol		
	New London		
Georgia	Griffin		
Kansas	Emporia		
	El Dorado		
Kentucky	Louisville		
Michigan	Wyandotte		
Mississippi	Meridian		
Montana	Bozeman		
S. Dakota	Aberdeen		
	Mobridge		
S. Carolina	Ninety-Six		
Tennessee	Milan		
Texas	Austin		
Virginia	Lynchburg		
Wisconsin	Columbus	Tomahawk	
	Edgerton	Waupun	
	Fond du Lac	West Bend	
	Glidden	Wis. Rapids	
	Hurley	Prairie du Sac	
	Johnson Creek	Watertown	
	Kenosha	Lake Geneva	
	Kaukena	Wausau	
	Lake Mills	Westby	
	Maxomanie	Boscobel	
	Mellen	Appleton	
	Menomonee Falls	Weyauwega	
	Milwaukee	Beaver Dam	
	Monocqua	Darlington	
	Neopit	Fennimore	
	Phillips	Menasha	
	Port Edwards	Ripon	
	Shawano	Lodi	
	So. Milwaukee		
Wyoming	Sheridan		
(Total = 14)	(Total = 54)		

but also the consideration of philosophical aspects. A summary of developments in fluoridation should review the present status of both technique and philosophy.

Investigation

"If you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of meagre and unsatisfactory kind."

—Lord Kelvin

It is common knowledge that many different food substances are required for normal health. It is less well recognized, however, that certain elements obtained in very small quantities from food or water are equally essential. Each individual, for example, requires about 2 mg. of copper and 8 mg. of iron each day for normal metabolism; a trace of iodine is required for normal thyroid activity. Recently, fluorine (as fluoride) has been added to the list of essential trace elements which must be obtained from food or water[2].

Extensive epidemiological studies have convincingly demonstrated, also, that an inverse relation exists between the fluoride content of natural waters and the prevalence of dental caries. The use of a drinking water containing the optimum concentration of fluoride, during the formative period of the teeth, is associated with a 60 to 65 per cent reduction in dental caries experience[4].

The optimum concentration of fluoride (F^-) has been accepted as 1.0 to 1.5 ppm., since the inverse relationship between dental caries prevalence and fluorides in water approaches its maximum at that value. The optimum concentration of fluoride is, at the same time, the minimum concentration of fluoride associated with the appearance of mottled enamel or dental fluorosis[5].

It was logical that the mass of evidence relating the fluoride content of water to the prevalence of dental caries should lead to an experiment to determine the effect of fluorides artificially added to a water supply deficient in that constituent.

Table 4
FLUORIDATION
Installations under Consideration

State	Community
Alabama	Birmingham
Arkansas	Little Rock
Florida	Tampa
	St. Petersburg
	Clearwater
Georgia	Columbus
Mississippi	Hattiesburg
Pennsylvania	Pittsburgh
S. Carolina	Rock Hill
Virginia	Danville
West Virginia	Wheeling
(Total = 9)	(Total = 11)

Studies reported in 1943 by Dean[6] and by Arnold[7] suggested that such an experiment should be made. In the same year, Ast[8] presented a detailed program for testing the fluoride-caries hypothesis by treating a public water supply under controlled conditions and concluded that if "this study proves to be practicable and effective, dentistry and public health may achieve a victory comparable with the control of many infectious diseases."

From the original epidemiological inquiry, the study of the relation of fluorides to dental health has expanded enormously. Dean has stated that it now includes the fields of water chemistry, biochemistry, pharmacology, physiology, histology, biometry, bacteriology, dentistry, medicine, public health, sanitary engineering, water works operation and, to a lesser extent, other special fields of science. Such an integration of related fields of study enhances and expands an investigation[9].

Hypothesis

A number of observations are collected, and then the scientist goes into a huddle

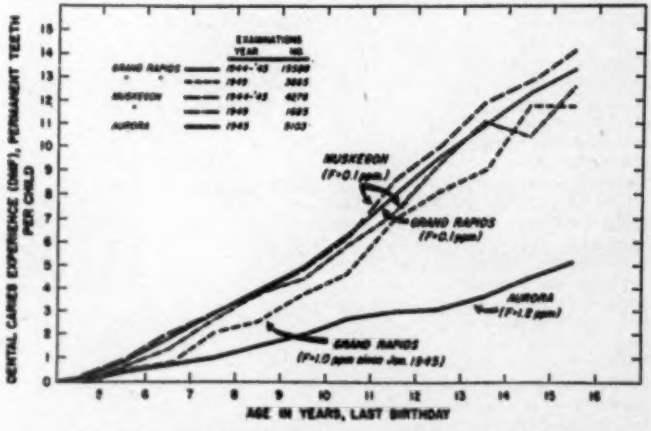

Fig. 3—Amount of Dental Caries Experience (DMF)—Permanent Teeth
(Records covering continuous resident school children in Grand Rapids, Muskegon and Aurora.)

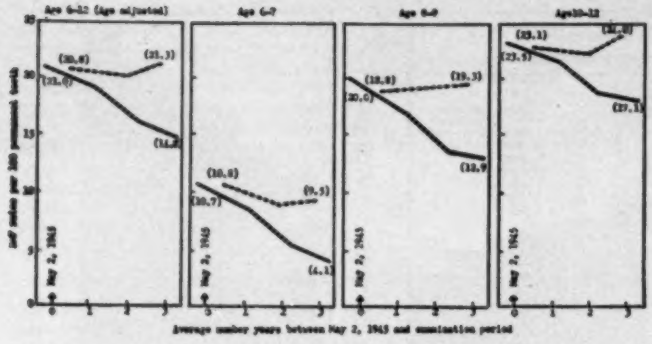

Fig. 4—Trends in DMF Rates of Permanent Teeth, 1944-49
Newburgh, N. Y.—fluoride city ———; Kingston, N. Y.—control city – – – –
(Sodium fluoride introduced into Newburgh's water supply May 2, 1945 as indicated by arrows at 0 years.)

with himself and forms a hypothesis, that is, a suggested explanation of the facts that have been observed.

—Anthony Standen in
'Science is a Sacred Cow'

The control of dental caries by artificial fluoridation of public water supplies is based on the hypothesis that a water so treated will have the same effect as one naturally containing fluorides. This hypothesis, at the inception of the experimental fluoridation studies, was developed almost entirely from epidemiological studies. Such studies provided presumptive evidence that artificial fluoridation should provide essentially the same effect as natural fluoridation.

The case for the supplementation of public water supplies is not weakened by the fact that most of the basic evidence is presumptive. All epidemiological evidence is presumptive[30]. The effect of added fluoride ion in substantially reducing dental caries is capable of scientific demonstration, and carefully conducted tests are under way to that end. Several years must elapse before the evidence supplied by these tests can be considered conclusive. In the meantime, however, many additional studies have provided evidence related to the hypothesis under investigation.

The mechanisms involved in the diminution of the incidence of dental caries have been summarized by Larner[31]. It has been established that, in areas where the drinking water has a moderate or high fluoride content, there is found an increased amount of fluoride in both enamel and dentine of the teeth. These teeth have surfaces which are harder, less easy to indent mechanically, and less soluble in acids. It has been known for some time that fluorides depress enzymatic reactions and thus reduce the metabolism of yeast, bacteria, and mammalian tissues. This, then, is another possible mechanism of fluoride[20] protection, since the production of lactic and other organic acids will be limited. The relative importance of each of these factors is not established, but both are known to be operative in reducing dental decay.

Knowledge of the toxicological and metabolic effects of fluorine-containing compounds has also been comprehensively reviewed by Larner[31]. His is an excellent report of the broad aspects of acute and chronic toxicity and of the mechanisms involved. On the ingestions of ordinary amounts (in water, less than 5 ppm.), fluoride is totally excreted — mostly in the urine. With larger amounts, about 50 per cent is excreted—and the remainder is stored, mostly in the bones and teeth.

The toxicity of fluorides, particularly in relation to their use in dentistry, has been well summarized by G. J. Cox[32]. The most delicate sign of fluoride toxicity, mottled enamel, may be found when the fluoridation of water is practiced. It will occur in only a very few individuals; the mottling will be very mild, and esthetic marring of the teeth should not be apparent. There is no known toxic effect of drinking water containing 1 ppm. fluoride, other than the "very mild" mottling of the teeth.

The role of nutrition in dental caries prevention has also been reviewed by G. J. Cox[33]. Consideration of a variety of related factors leads to the conclusion that, while others may aid in the formation of caries-resistant teeth, none but the concentration of fluoride has been clearly demonstrated.

The discussion presented in the new A.W.W.A. *Manual of Water Quality and Treatment*[5] also provides a practical concept of toxicity considerations. Sublethal toxic effects are reported to follow the ingestion of about 230 mg. of fluoride, and the lethal dose is considered to be about 4 grams. These are enormous concentrations in terms of chemical applications at water treatment plants. Calculations show that it would be necessary to add over one ton of sodium fluoride to each million gallons of water to provide the sublethal amount. It would be necessary to add approximately twenty tons of sodium fluoride to each million gallons of water to provide the lethal dose. Applications of this order are far beyond the capacity of chemical feeders installed in water plants for fluoridation treatment.

Experiment

The final step is to do the appropriate experiment, and see if the hypothesis is substantiated. If the experiment agrees, the hypothesis is accepted tentatively.

—Anthony Standen

Following preliminary basic studies, the application of fluoride was started as an experimental study in three public water supplies during 1945: at Grand Rapids, Mich., in January; at Newburgh, N. Y., in May; and at Brantford, Ont., Canada, in June. The corresponding control cities used in the study are Muskegon, Kingston, and Sarnia. In the same year the experimental fluoridation of an institutional supply was started at the Southbury, Connecticut, State Training School, and another training school is used as the control.

The most extensive review of post-fluoridation dental caries reductions has been prepared by Stadt[1], on the basis of reports and estimates. He emphasizes that these reductions are post-eruptive effects rather than enamelification developments. A summary of the Stadt data for seven installations, with report periods ranging from 5 years to one year, is presented in Table 5.

Grand Rapids, Mich.

Fluoridation of the Grand Rapids water supply has been in progress since January, 1945. A uniform concentration of 1.0 ppm. fluoride ion is maintained in the distribution system. The control city is Muskegon, where the water supply has a fluoride ion content of 0.1 ppm. Base-line data on dental caries rates were collected in these cities, prior to the start of fluoridation treatment, and also in Aurora, Ill. The public water supply of Aurora has a naturally occurring fluoride ion content of 1.2 ppm. Detailed examinations were made of virtually the entire school population of these cities. Examinations of samples of children in Grand Rapids and in Muskegon have been made yearly, and will con-

Table 5
POST-FLUORIDATION
Dental Caries Experience Summarized

City	Report Period —After	Age Group	Caries Reduction
Grand Rapids, Mich.	5 years	Age 6 Age 7 Age 8	Caries experience conforming to curve typical of water containing 1 to 1.5 ppm. F
Brantford, Ont.	54 months	Age 6 Age 8 Age 12 Age 14	56.0% DMF* 43.0% DMF* 22.0% DMF* 20.0% DMF*
Sheboygan, Wisc.	44 months	Kindergarten Grade 4 Grade 7–9	39.6% def 24.4% DMF 18.0% DMF
Lewistown, Idaho	3 years	Age 7 Age 8 Age 9	58.0% DMF 35.0% DMF 25.0% DMF
Newburgh, N. Y.	3 years	Ages 6–12	30.0% DMF
Marshall, Texas	29 months	Age 6 All school ages	47.0% DMF 23.0% DMF
Evanston, Ill.	12–23 months	Age 6 Age 7 Age 8	49.8% DMF** 32.5% DMF** 22.3% DMF**

* Computed by Z.M.S.
** Computed by Z.M.S.: Not attributed only to fluoridated water
Note: Symbol def = (decayed, extraction indicated, or filled) deciduous, or primary, teeth
Symbol DMF = (decayed, missing, or filled) permanent teeth

tinue to be made for the duration of the study. The total number of children examined in these cities is shown in Table 6.

Dean, Arnold, Jay and Knutson[14] have analyzed the findings of detailed dental examinations made in 1949. Their data for Grand Rapids children in the 6, 7, 8, and 9 year-old age groups are summarized in Table 7.

The 1949 data on Muskegon children warrants comparison only in the six- and nine-year-olds because of the limited number examined. The six-year-olds in 1949 showed a 22.2 percent reduction from the 1944-45 DMF rate; the nine-year-olds, a 1.8 percent increase.

If one compares the rates of five-, six-, and seven-year-olds at Aurora with the present Grand Rapids rates for children in these age groups, it is apparent that the DMF experience is quite similar. When these rates are compared with the 1944-45 Grand Rapids rates, the percentage reductions also tend to be alike. However, a very limited number of erupted permanent teeth in five-year-old children, and a small sample of children in the seven-year-old group for Grand Rapids in 1949 are the basis for these rates.

Figure 3 is a graphical summary of the data reported by Dean, Arnold,

Table 6
FLUORIDATION STUDY
Distribution of Children Examined
Ages 4 to 16

		Total Children	Continuous Residents
Grand Rapids, Mich.,	1944-45	28,614	19,680
	1949-50	5,102	3,672
Muskegon, Mich.,	1944-45	7,786	4,291
	1949-50	2,493	1,695
Aurora, Ill.,	1945-46	8,312	5,116

Table 7
POST-FLUORIDATION
Dental Caries Experience—
Permanent Teeth
Grand Rapids, Mich.

School Age Group	DMF Teeth per Child 1944-45	1949-50	% Reduction
6	.78	.38	51.3
7	1.89	.76	59.8
8	2.94	2.16	26.5
9	3.90	2.48	36.4

Jay and Knutson[14]. The 1949 dental caries experience in Muskegon roughly follows the 1944-45 base line. The 1949 trend for five-, six-, and seven-year-old children in Grand Rapids falls on the Aurora line, but for older children, aged 8 to 16 years, the Grand Rapids trend line is appreciably above that of Aurora. Findings are considered to indicate that the reduction in dental caries is most pronounced in the younger age groups whose dentition was largely calcified following the maintenance of 1.0 ppm. fluoride ion in the previously fluoride-free public water supply. Sufficient time has not elapsed to evaluate water fluoridation in the older age groups.

Newburgh, N. Y.

Fluoridation of the Newburgh water supply has been in progress since May, 1945. A concentration of 1.0 to 1.2 ppm. fluoride ion is maintained in the distribution system. The control city is Kingston where the water supply is practically fluoride-free. Baseline data were collected by means of detailed dental examinations of all school children aged 6 to 12 in Newburgh prior to the start of fluoridation treatment. Repeated dental examinations have been made in Newburgh and in Kingston for the following three years.

The dental findings after three years of fluoridation have been reported by Ast, Finn and McCaffery[15]. In order to determine more accurately the trend, they have considered only those children age 6 to 12 who were in the original base study and who have had each successive examination until they reach age 12. Approximately 3,400 children are included in the Newburgh data and 2,800 children

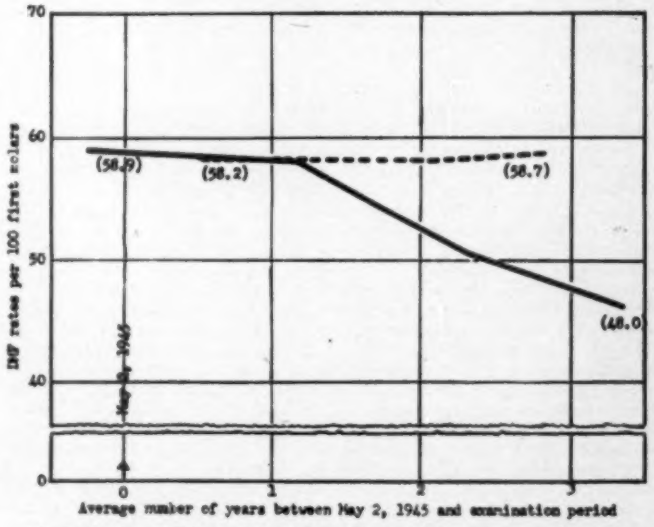

Fig. 5—Trends in DMF Rates of First Molars of School Children 6 to 12 Years of Age Newburgh, N. Y.—fluoride city ———; Kingston, N. Y.—control city – – – –
(Sodium fluoride introduced into Newburgh's water supply May 2, 1945 as indicated by arrows at 0 years.)

Fig. 6—Sheboygan Survey Data—DMF Teeth Per Child

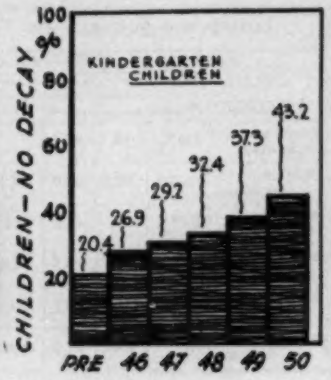

Fig. 7—Sheboygan Survey Data—Children With No Decay

are reported in the Kingston data. The study group will cover only those children assumed to have continuous residence in their respective cities.

The details of the preliminary report show the DMF rate for permanent teeth to exhibit a consistent downward trend in Newburgh from 21.0 to 14.8 per 100 permanent teeth. This indicates a saving of 6.5 permanent teeth per 100 in Newburgh as compared with a rate of 21.3 per 100 in Kingston at the last examination. The saving represented is 30 per cent. Trend data are illustrated in Fig. 4.

Among first molars, which account for the major part of the caries problem in children, after three years of fluoride experience, Newburgh's rate was 48.0 DMF per 100, while Kingston's was 58.7; a difference of 10.7 DMF per 100 first molars. The saving represented is 18 per cent.

The trend in the DMF rates of the first molars was the same in Newburgh and Kingston during the first post-fluoridation year of the study. This suggests that there was little, if any, benefit to the first molars during the first year of fluoridation. The departure from this trend in the second and third years of fluoridation was notable. Data illustrating this trend is shown in Fig. 5.

The differences in dental caries experience between Newburgh and Kingston are considered by Ast, Finn, and McCaffery to suggest the possibility of benefits from exposure to fluoridated water subsequent to enamel calcification and subsequent to eruption of the first molars. They consider the data preliminary, and cite the necessity for continuing the collection of data for the proposed duration of the study (through 1954 to 1956), to obtain additional information concerning the caries prophylactic value of fluoridation.

Other Data

Reductions in dental caries prevalence have been noted in other cities where fluoridation is practiced. At Sheboygan, Wisc., fluoridation application was started in February, 1946[9]. The DMF rate for deciduous teeth has declined steadily from year to year since the start of the program; this is shown by the data in Table 8

Table 8
POST-FLUORIDATION
Dental Caries Experience—
Deciduous Teeth
Sheboygan, Wis.

	DMF Teeth per Child (Kindergarten)
Prefluoridation	4.80
1946	4.32
1947	4.09
1948	3.46
1949	2.90
1950	2.58

and is illustrated in Fig. 6. There has also been a steady year-by-year increase in the percentage of kindergarten children with no tooth decay; this is shown by the data in Table 9 and is illustrated in Fig. 7.

An important preliminary report has been made by Schlesinger, Overton, and Chase[11] on the pediatric aspects of the Newburgh-Kingston fluoridation study. Planners of the project recognized the value of including a pediatric research clinic, utilizing laboratory and x-ray methods of study. Initially a group of 500 children was chosen for study in each city; in Newburgh a group of 25 children of various ages has been given special ophthalmological examinations; and other special studies are being conducted or planned. A comparison of the results of the pediatric examinations at the start and three years after the introduction of fluoridation in this study has failed to disclose any significant difference between the two cities in any of the factors studied.

The significance of the data accumulating in these and in other experimental studies has not been questioned. No reasons have been suggested for suspecting that successive dental examinations at such installations will not follow the same trend. Neither is there any evidence that the artificial maintenance of a concentration of 1.0 ppm. fluoride ion in water differs in effect from the same concentration occurring naturally.

Problems

In Nature's battle against disease the physician is but the helper who furnishes Nature with weapons, the apothecary is but the smith who forges them.

—Paracelsus

The water works operator has found the installation and operation of equipment required in the practice of fluoridation to be relatively simple. The new, or different, problems presented by this treatment may be summarized:

1. The chemical feeding devices employed must operate with a degree of accuracy somewhat higher than that of conventional equipment.
2. The new chemical materials are toxic, and must be handled with exceptional precautions.
3. The determination of residual fluoride ion in treated water constitutes a new and essential technique.

Devices for feeding fluorides accurately have generally been adapted from those machines originally designed for accurately applying chemicals in water treatment and in industrial processes. An adequate range and variety of fluoride feeders has been developed by equipment manufacturers.

A recent and useful development is a so-called saturator[12], a device in which water passes down through a bed of crystalline sodium fluoride. The sodium fluoride is supported by a straining device, and thus a saturated fluoride solution is maintained. A sodium fluoride of larger particle size (20 to 40 mesh) has been produced for use with the saturator, in order to permit an increase in the rate of flow

Table 9
POST-FLUORIDATION
Dental Caries Experience—
Deciduous Teeth
Sheboygan, Wis.

	Percentage Kindergarten Children No Dental Caries
Prefluoridation	20.40
1946	26.92
1947	29.17
1948	32.40
1949	37.30
1950	43.20

of water through the bed. Sodium silicofluoride, being relatively insoluble, may be fed efficiently by means of equipment designed for the preparation and application of a slurry[20]. This equipment includes a slurry storage tank having a baffled outlet and equipped with an agitator, and a solution feeder adapted to pumping a slurry. These developments extend the range and applicability of solution feed devices.

The application of hydrofluoric acid at Madison, Wis., has been described by Smith[20]. In this method of feeding, a displacement method is employed: the displacement liquid must be of a different density than the hydrofluoric acid and must not react with it. Hydrofluoric acid is extremely dangerous to handle and, for that reason, will probably not be widely used as the source of fluoride. However, hydrofluosilicic acid is presently being considered for fluoridation, and feeding equipment of a similar type may be required for this material.

The fluoride compounds available for water fluoridation have also been well summarized by Maier[20]. He points out that sodium fluoride was adopted both because of its convenience and because studies of its toxicity and physiological effects had been completed. Obviously, many other compounds might be used. The characteristics of compounds which appear to be suitable, on the basis of availability, cost, and purity, are illustrated in Fig. 8.

Sodium silicofluoride is considered the most promising present source of fluoride, when cost is balanced against convenience in handling. Studies reported by McClure[20] show the availability of the fluoride ion in sodium silicofluoride is comparable to that in sodium fluoride. The relatively low solubility of the silicofluoride will, however, require the application of relatively large volumes of solution or of a slurry. The plant scale application of sodium silicofluoride, as a trial run, was first reported by Zufelt[20]. His results indicated no difference in the reaction of this compound as compared with the previously used sodium fluoride.

There is evidence that continuous exposure to cryolite and phosphate rock dust, whereby probably 15 to 25 mg. fluoride per day was inhaled, has caused skeletal changes (bone damage, or osteosclerosis). As a result, industrial hygienists have set a threshold limit of 2.5 mg. fluoride per cubic meter of air. Maier[20] has discussed the problem of handling fluorides in water treatment plants so as to limit the concentration of dust in the atmosphere. In smaller plants, where the hopper or solution tank is replenished by means of a scoop, little dust is generated if the fluorides are handled carefully. The greatest hazard occurs in the larger plants, where the fluorides are dumped from containers into a hopper opening at floor level. When filling hoppers, operators should wear masks. A mask designated BM2101 and a filter designated BM2133 (both by the Bureau of Mines) is recommended to insure a satisfactory degree of protection for this purpose.

Where fluorides are dumped from containers into a hopper, dust exhaust and filter equipment should be provided.* The details of these devices, as installed at the Sheboygan, Wis., water plant, have been described by Zufelt[20]. He states that no reason existed to doubt the effectiveness of the precautions provided, but that tests of the fluoride concentration in the air were made as an additional guarantee. Results of a study by industrial hygiene engineers showed the safety measures to be entirely effective. In addition, urinalyses were made of plant employees and were found to show results well below the level considered excessive.

As a further measure of protection, it is recommended[20] that the equipment installed for dry feeding of fluorides should include a hopper requiring filling no oftener than once each twenty-four hours. An approved dust mask and rubber gloves should be worn during the filling operation, and the hands should be washed after each filling. Spilled fluorides should be wet-mopped and discarded. The hazards involved in handling hydrofluoric acid have been recognized in the special precautions observed at the Madison plant[20].

COMPOUNDS SUITABLE FOR FLUORIDATION OF WATER

DATA FROM F. J. MAIER, USPHS		COMMERCIAL MATERIAL					
CHEMICAL	FORMULA	PURITY OF CHEMICAL PER CENT	FLUORIDE CONTENT PER CENT	FLUORIDE ION PPM IN SATURATED SOLN. AT 77°F.	SAT. SOLN. 77°F. LBS./100 GALS. WATER FOR 10 PPM F⁻	CHEMICAL COST DOLLARS/LB.	FLUORIDE ION COST DOLLARS/LB.
CALCIUM FLUORIDE	CaF_2	98	47.7	19.1	52,500	.02	.042
SODIUM SILICOFLUORIDE	Na_2SiF_6	98.8	60.0	4,572	219	.0323	.054
SODIUM FLUORIDE	NaF	94	42.5	17,200	58.2	.105	.248
SODIUM FLUORIDE	NaF	98	44.4	18,000	55.6	.115	.26
HYDROFLUOSILICIC ACID	H_2SiF_6	30	23.7	DIRECT FEED	3.8	.05	.21
HYDROFLUORIC ACID	HF	60	57.0	DIRECT FEED	1.4	.135	.237

Fig. 8—Compounds Suitable for Fluoridation of Water
(Adapted from Maier—see Ref. 20 in list of references.)

*A recent design of gravimetric feeder provides a dust proof hopper to hold one or two bags of chemical.

Ed. Note: Since the writing of this paper an up to the minute paper by R. S. Phillips has appeared in Water & Sewage Works for March 1951. The author discusses experiences at Charlotte, N.C., during the first year of Fluoridation, including safety measures.

Proper operation of a water fluoridation installation should maintain the fluoride concentration well within a variation of 5 per cent from the intended application. This accuracy is considered greater than that attained by present tests for residual fluoride in water. Maier[20] has presented a discussion of ionic interferences with the standard test for fluorides, the Scott modification of the Sanchis Method. The test is based on the degree of decolorization of a zirconium-alizarin lake in an acid solution. The reagent employed is relatively unstable, the color range is narrow, and the color development requires about an hour.

Interferences in the alizarin method of fluoride determination have been investigated photometrically by Taras, Cisco, and Garnell[27]. Free available chlorine and manganic ion were found to affect the readings positively, and aluminum ion to lower the fluoride value. Free available chlorine can be eliminated by the addition of sodium thiosulfate or by ultraviolet irradiation; manganese dioxide by reduction with hydrogen peroxide. No impairment in the visual or photometric procedure attends the use of these reagents.

The Lamar reagent[20] is reported to be more stable and to have a broader color range than other reagents[20]. A study has recently been reported by Ingols, Shaw, Eberhardt, and Hildebrand[20] of the determination of the fluorides ion with ferric thiocyanate.

Development of a simple, accurate, and rapid method for the determination of fluoride in water is important.

A subcommittee of the Standard Methods Committee of the AWWA is attempting to develop such a method; in particular one which will follow Beer's law and could be used with colorimeters and permanent color discs. At the present time study is being devoted to a method employing aluminum and hematoxylin; this is a bleaching reaction and there are indications that it will follow Beer's law. Much further work is likely to be required[39].

Meanwhile, for the plant control of fluoridation, commercial comparator outfits are available. Where the accuracy required is within 0.2 ppm. fluoride, and where interference is negligible, these outfits are satisfactory for routine use. Permanent color standards of liquid[40] or of glass[41] are used in comparators which are standard for other types of colorimetric water analysis.

Philosophy

The water works man of today has still a world to conquer.

—Abel Wolman in
The Quest for Pure Water

It is becoming increasingly evident that the public water supply may be used "as a carrier for elements or complexes which would improve or raise the general level of the public health of the community." When Wolman[42], in 1943, discussed the fluoride-caries hypothesis and the suggestion that it be tested by experimental installations, he recognized this use as posing a new question for water works operators. Even at that time, however, he recommended that there should be an understanding of the reasons underlying the suggestion, and that it should be evaluated as a new opportunity for service,

There is a new philosophy involved in the fluoridation of public water supplies, and the ethical questions involved have been carefully considered by Black[29]. Five of the ten principles set forth in the AWWA Code of Practice are emphasized as bearing upon the question, all relating essentially to the advancement of public interest as well as to the preservation of public health.

Black analyzes the basic issues which apply to this problem as those of value, right, and obligation. His conclusions concerning these basic philosophical principles may be summarized as an attempt to prove, from purely ethical considerations, that "society has the right to expect that those things be done which contribute to the public welfare, provided they are reasonable and practical." His evidence also leads to the conclusion that "decisions on matters of major policy which affect the public welfare should be made by those professions or groups most qualified from the standpoint of training and experience to make them."

The simple and summary statement of policy and procedure by the A.W.W.A. with reference to the fluoridation of public water supplies[30] is in accord with these principles. The statement, in effect, says to the medical and dental professions: "If, in the light of all available evidence, you believe that the fluoridation of public water supplies is in the interest of group health, the water works industry stands ready, as it always has and always will, to participate with you in its practical realization."

Fluoridation of the public water supply on an empirical basis, to provide mass partial control of dental caries is now an authoritatively recommended practice. Recommendations generally include the requirement that the practice of fluoridation must have the approval of local dental, medical, health, and other governing agencies, and must meet the requirements set forth by the state health authorities. Primary consideration is given to the continuation of fluoridation on an experimental basis.

The most recent approval of fluoridation was that, late in 1950, of the American Dental Association[43]. The practice has received the recommendation of the U. S. Public Health Service, the State and Territorial Dental Directors, some State Departments of Health, some State and Local Dental Societies, and of other groups[4]. It is reported that the American Medical Association has not taken a stand for or against the practice of fluoridation[44].

Appraisal

Others will tell you to try to prove that you are right; but I tell you to try to prove that you are wrong.

—Louis Pasteur

The fluoridation of public water supplies is both a continuing experiment and a growing practice. The number of empirical installations grows rapidly, even while further experimental studies are planned. Important questions of practical and of research nature remain to be answered.

Chemicals: Supply and Cost Considerations

First in importance in the continued practice of fluoridation is the availability of an uninterrupted supply of chemical; second is the selection of that chemical which will be both suitable and effective at the lowest cost.

According to Maier[45], it is estimated that more than eight times the present annual consumption (10,000 tons) of sodium silicofluoride could be produced at the present rate of phosphate salt production. It appears then, that from this source alone, there is enough fluoride potentially available to add 1.0 ppm. to the water consumed by the entire population of the U. S.

The industrial development of fluorine compounds has expanded tremendously in the past five years[46]. This development has derived mainly from the demands of the Manhattan Project for greases and lubricants which are chemically inert and resistant to high temperatures and pressures. Completely fluorinated hydrocarbons were synthesized and found to fit these needs. As a result of subsequent investigations, fluorine compounds have now found wide industrial applications.

Late in 1950, definite shortages were reported in supplies of sodium fluoride and of sodium silicofluoride[47]. The reasons for this were not clearly explained, but appeared due to a situation in the chemical industry involving limited production of sulfur, sulfuric acid, and soda ash—all of which are related to the availability of fluorides. The opinion has been expressed that these shortages will be temporary, and that the supply of fluorides can normally be expected to expand with the need for these chemicals. There is evidence of the increasing selection of sodium silicofluoride as the preferred treatment chemical; the fluoride ion obtained from this source will probably cost about one-quarter to one-half as much as that obtained from sodium fluoride.

Geographical Studies Needed

The maintenance of a fluoride concentration of 1.0 to 1.2 ppm. is probably the optimum for the north central area of the U. S., but is not necessarily the best for all areas. Within limits, the severity of fluorosis and the degree of caries protection varies with the fluoride intake. The fluoride intake depends largely upon the amount of water consumed—and the consumption of water depends upon the temperature and relative humidity.

Data at present available do not enable the formulation of definite conclusions as to the relationship between the optimum fluoride content of water and the factors of air temperature and relative humidity. Regulation of the fluoride concentration to approximate this relationship is practiced in the fluoridation program in Charlotte, N. C.[48,49] The fluoride application is varied on the basis of a monthly cor-

relation with air temperature and with the probable variation in water intake, as illustrated in Figure 9. More extensive studies of climatalogical influences are required to determine accurately the optimum concentration of fluoride which should be maintained in a given water supply.

A Technical Problem

The only serious technical problem resulting from the fluoridation of a public water supply has been that of the ice manufacturing industry of Charlotte, N. C. It was generally observed that blocks of ice prepared from the fluoridated water were shattered in a high percentage of cases. The practice of fluoridation, which was started in April 1949, was suspended after one month to allow for an investigation of the complaint. Stadt and Phillips[36] confirmed the effect and, after further tests, recommended that anti-crack compounds be employed. These compounds are ordinarily used to prevent the shattering of manufactured ice when this results from the lowering of brine temperature below 16° F. (to temperatures of 8° to 10° F.).

The practice of fluoridation was resumed on August 4, 1949, and has been in continuous operation since that time. No further complaints have been received from the ice industry or from any other source. Charlotte water has a dissolved solids content of about 45 ppm. It has been suggested that the addition of 2.4 ppm. of sodium fluoride represents a high proportional increase in the dissolved solids, and that this condition may have caused the ice to shatter. The phenomenon has been completely eliminated by adding the equivalent of 20 ppm. of ammonium chloride to the water used for the manufacture of ice. No such experience has been reported elsewhere.

Materials and Methods

The AWWA is actively interested in the continued evaluation of fluoridation practices. Accordingly there has been organized a "Task Group" to maintain contact with and to report on fluoridation materials and methods[37]. The duty assigned is that of reporting new developments in fluoridation practice, at least once each year, to the Water Purification Division of the Association. In the meantime, the AWWA "Committee on Policy re Fluoridation of Public Water Supplies" is being continued.

The Advancement of Fluoridation

There is every evidence that studies of experimental installations of fluoridation will continue, on more critical, more detailed, and more specialized lines of investigation. The evidence which results will be correspondingly more conclusive. During the period of "watchful waiting," the trend toward an ever-growing number of empirical installations of fluoridation is indicated[38]. The waterworks profession has done, and will continue to do, its part in this new contribution to public health.

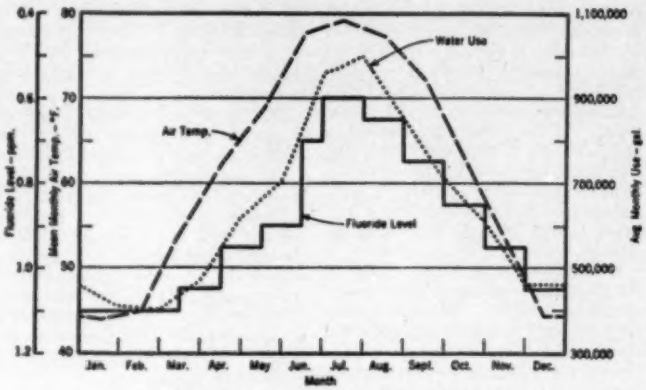

Fig. 9—Water Consumption, Air Temperature and Fluoride Level
(After Stadt & Phillips—Ref. 36)

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AWWA President Speaks on Controlled Materials

"The situation is progressing from disorganized chaos to one of organized confusion." So spoke W. Victor Weir, President of the St. Louis County Water Co., and current President of the Amer. Water Works Assn. Mr. Weir was addressing the Spring Meeting of the N.Y. Section of AWWA at Albany on April 5 and he was talking about "Controlled Materials."

Pointing out that things will get worse before they get better, Mr. Weir called attention to the expenditures for water works in 1950, amounting to $215 million. Now with a backlog of seven times that, the water works business wants to spend one and a half times the 1950 rate in 1951. Inasmuch as there is not enough material for that, we must have controlled materials, and the water works industry must compete with other industries for those materials.

Mr. Weir continued his discussion with comments on what governmental orders affect the water works industry. There was for example NPA-1 which has particular reference to anti-hoarding of copper. Next there was the M-12 Order on copper, which states that beginning April 1st, a water supplier can use only 75 per cent of the average amount of copper he used per month last year.

Chlorine Order M-31

The most important order to date and the most beneficial to the water works industry is the M-31 Order on Chlorine which insures that a supplier will furnish to a water plant as much chlorine as was used in 1950. Mr. Weir said that a certificate of necessity had been granted to chlorine producers to increase their output by 3000 tons per day and that this capacity is expected to be available by 1953.

The M-4 Order requires permission to plan or construct any buildings to house office operations but has no effect on producing or distribution facilities for water supplies.

Another recent order NPA Regulation No. 4 gives the right to water suppliers to use DO-97 Orders—It also gives that right to everyone else. DO-97 Orders may be used for MRO (Maintenance, Repair, and Operation) and for supplies for minor capital additions up to $750. Mr. Weir believes that these orders won't do water works much good, and probably won't help water works suppliers. If one uses a DO-97, he must establish a quota from his 1950 uses. Obviously, one can not obtain as much material as in 1950 for the same dollars, because prices have risen. It is possible to ask for relief from the restrictions of such a quota by stating that the regulation is unfair and against the best national interests, etc., but no one knows what results that will bring.

Mr. Weir says that the use of DO-97 is a sure way to commit business suicide, inasmuch as it will use up any allotment under MRO and short a utility on requirements for expansion as well as operation. Furthermore, it can not be used for an expenditure over $1000 and if a special permission is obtained for an expenditure of over $1000, that can not include any material that was purchased under a DO-97. Mr. Weir quoted comment of business men in Washington to the effect that "A DO-97 won't get any material; it is better to be an old customer of a supplier."

Meanwhile, the water works industry is waiting for some help in Washington. The establishment of a claimant agency has been completely fouled up. Both the gas and electric industries have made progress in obtaining a claimant agency and special consideration for their needs, but the water works industry is still outside looking in.

Mr. Weir says we must look forward to CMP (Controlled Materials Plan) which now seems scheduled to go into operation about July 1. We must have that if the water works industry is to get what it needs. As of April 1st, the situation described above prevailed. What it will be a month hence can not be guessed.

Civil Defense and Mutual Aid

The other principal topic at this meeting was a Panel Discussion of "Civil Defense and Mutual Aid." Chairman of the panel was Earl Devendorf, Director, Div. of Envir. Sanit., State Dept. of Health, Albany, N.Y., and Water Coordinator for the State. In addition to Mr. Devendorf's comments on the provisions for Mutual Aid, which has been retained by law since the war, three speakers presented three aspects of the subject. C. R. Cox, Chief, Water Supply Section, Bur. Env. Sanit., State Dept. of Health, Albany, spoke on "State Wide Problems"; James C. Harding, Commissioner of Public Works, Westchester County, White Plains, N.Y., spoke on Zone Problems; and Elon P. Stewart, Div. Engineer of Water, City of Syracuse, N.Y., spoke on "Local Problems."

The meeting closed with a round table conference on water works operation, and a paper on "Control of Taste and Odor by Excess Chlorination" by Thomas M. Riddick, Cons. Engr., New York City.

Business Session

Officers for the ensuing year include: *Chairman*, Robert W. Austin, Hyd. Engr., Pub. Serv. Comm., Albany, N.Y.; *Vice Chair.*, John G. Copley, Supt. of Water, Elmira, N.Y.; Trustees include James R. Losee, Tarrytown, N.Y.; S. P. Carman, Binghampton, Everett Rowley, Lynbrook, N.Y.; and Thomas B. Tyldesley, Watertown, N.Y.; the last two elected at this meeting.

The Fuller Awardee of the New York Section chosen for this year was Linn H. Enslow, Editor, *Water & Sewage Works*, New York City. The citation covered Mr. Enslow's long service to the Amer. Water Works Assn. and to the water works industry.

Basic Factors In Centrifugal Pump Application*

Part 3—Characteristic Curves and Centrifugal Pump Relations.

by ROY CARTER *and* I. J. KARASSIK, *Application Engineers, Worthington Pump and Machinery Corp., Harrison, N.J.*

UNLIKE positive displacement pumps a centrifugal pump operating at constant speed can deliver any capacity from zero to some maximum value which derives from the design and size of the pump, and suction conditions. The total head developed by the pump, the power required to drive it, and the resulting efficiency vary with the capacity. The interrelation of capacity, head, power and efficiency is commonly known as the "characteristics of the pump." These interrelations are best shown in graphs which reveal the pump's "characteristic curves." In such graphs it is usual to plot the head, the power input and efficiency against capacity at a constant speed, as shown in Fig. 12. However, it is possible in connection with special problems to plot any three components against any fourth component. When variable speed drivers (motors, etc.) are used, a fifth component, the operating pump speed expressed in rpm. is involved. Where suction conditions may be critical, the limit of suction lift vs. capacity or required "net positive suction head" (npsh.) vs. capacity is often shown. (Note—npsh. was defined and illustrated in Part 2.) In pump design or application studies many other relations may be shown on the same graph.

In Fig. 12 the curve H-Q, showing the relation between capacity and total head, is called the head-capacity curve; and, pumps are often classified on the basis of the shape of their head-capacity curves. This feature will be discussed more in detail later.

The curve N-Q in Fig. 12, showing the relation between efficiency and capacity, is properly called the efficiency-capacity curve, but is commonly referred to merely as the efficiency curve.

The curve P-Q in Fig. 12, showing the relation between power input and pump capacity is the power-capacity curve, but is generally referred to as

* The third of a series of articles on the understanding of and the selection and application of centrifugal pumps. Parts 1 and 2 are to be found in the January and February 1951 issues of this magazine.

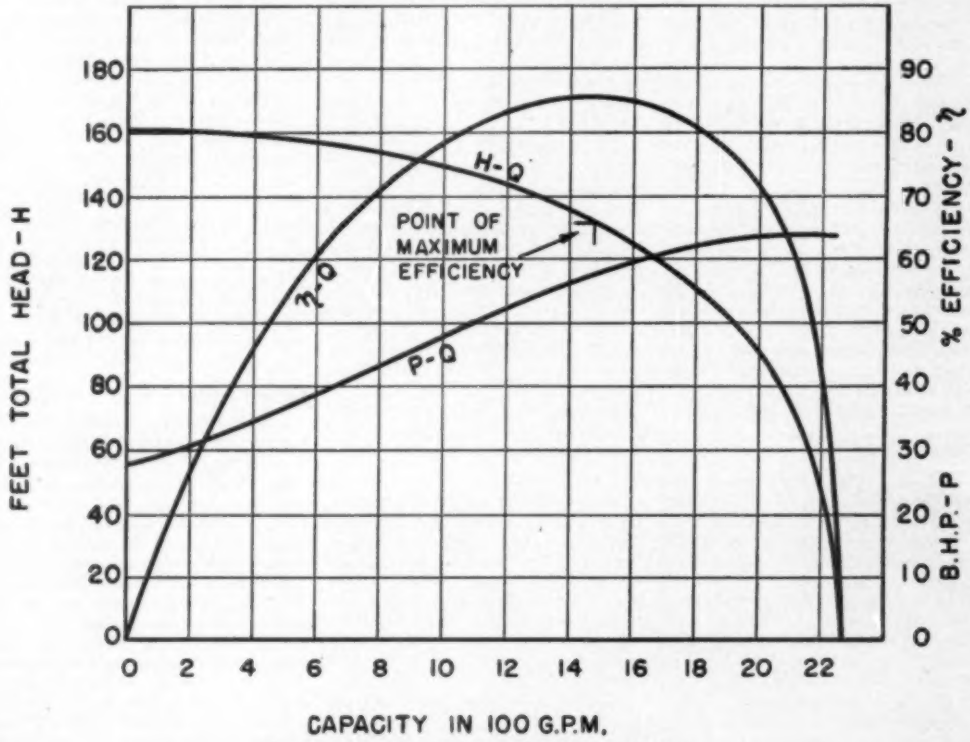


Fig. 12—Specimen Graph of Centrifugal Pump Characteristics

Double suction, single stage volute pump at 1760 RPM with 8" suction and 6" discharge.

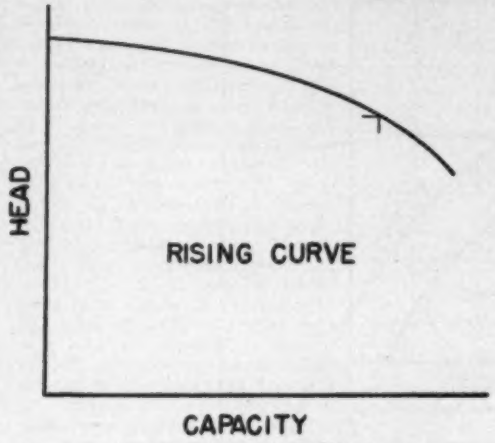


Fig. 13-a—Rising Head—Capacity Curve

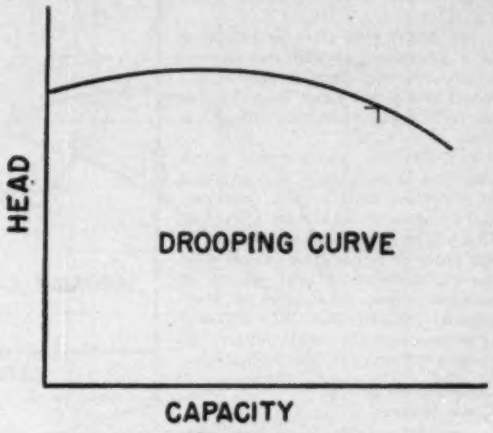


Fig. 13-b—Drooping Head—Capacity Curve

the power curve; or as the brake horse-power curve, or the "bph." curve.

Usually the graph of a pump characteristic is made for a capacity range of zero to the maximum operating capacity of the unit. The scales on the graph for head, efficiency and bhp. all have the same zero line at the base of the graph—see Fig. 12.

In some cases, the curve is made for a limited range in capacity. In other cases, to permit clearer presentation, the head, the efficiency and the power scales are so selected that their zero lines do not coincide. Also, these scales may be enlarged so that their full range cannot be shown on the graph. An example of such plotting of the characteristics of a pump is illustrated by Fig. 18.

Classification of H-Q Curve Shapes

As mentioned above, pump head-capacity curves are often classified by their shapes. Terminology in common use is:

(a) *Rising characteristic* or, more correctly, rising head-capacity characteristic, meaning a curve in which the head rises continuously as the capacity is decreased. (See Fig. 13-a.)

(b) *Drooping characteristic*, a shortened form of the true name of drooping head-capacity characteristic, covering cases in which the head-capacity developed at shut-off is less than that developed at some capacities. (This is also known as a looping curve.) (See Fig. 13.)

(c) *Steep characteristic*, referring to a rising head-capacity characteristic, in which there is a large increase in head between that developed at design capacity and that developed at shut-off. It is sometimes applied to a limited portion of the curve; for example a pump may be said to have a steep characteristic between 50% and 100% of the design capacity. (See Fig. 13-c.)

(d) *Flat characteristic*, referring to a head-capacity characteristic in which the head varies slightly with capacity from shut-off to design capacity. The characteristic might be, in addition, either drooping or rising. All drooping curves have a portion in which the head developed is approximately constant for a certain range in capacity. In such cases that range is called the flat portion of the curve. The qualification of flat is also applied at times to indicate the general shape of other curves either for their full

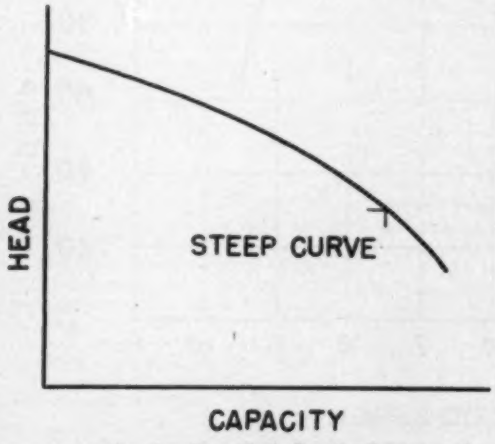


Fig. 13-c—Steep Head—Capacity Curve

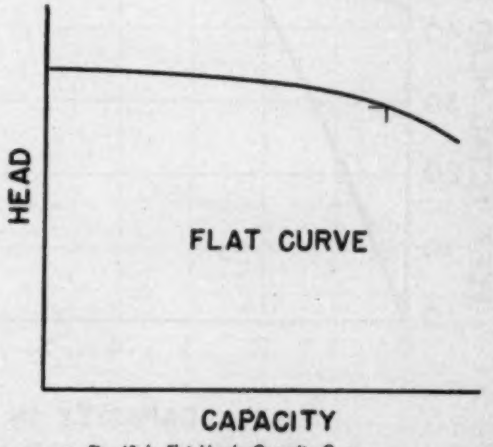


Fig. 13-d—Flat Head—Capacity Curve

range or for a limited range. (See Fig. 13-d.)

(e) *Stable characteristic,* referring to a head-capacity characteristic in which only one capacity can be obtained at any one head. Basically this has to be a rising characteristic. (See Figs. 13-a, -c, -d.)

(f) *Unstable characteristic,* referring to a head-capacity characteristic in which the same head is developed at two or more capacities. (See Fig. 13-e.) The successful application of any pump is dependent as much upon the characteristic of the system on which it is operated as upon the head-capacity characteristic. Most pumping systems permit the use of pumps with moderately unstable characteristics.

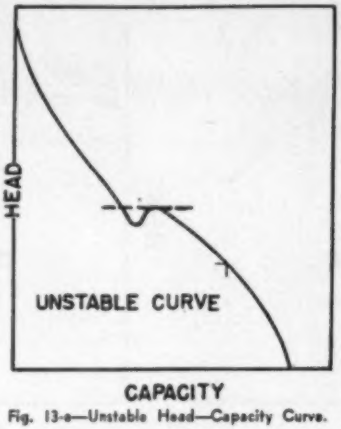


Fig. 13-e—Unstable Head—Capacity Curve.

Classification of P-Q Curve Shapes

In addition to the names applied to the shape of the head capacity (H-Q) curves, the power-capacity (P-Q) curves have also been classified according to their shapes. Fig. 14 illustrates a pump characteristic with a power (P-Q) curve (bhp. on graph) which flattens out and then decreases as the capacity increases beyond the maximum efficiency point. This is called a non-overloading curve. When the power (P-Q) curve continues to increase with an increase in capacity, as in the characteristic shown in Fig. 8 as the (bhp.) curve, the pump is said to have an overloading curve. The shape of the power curves (P-Q or bhp.) varies with the specific speed type. As a result the power curve may be one which has a very low value at shut-off, as illustrated in Figs. 14 and 15, or it may be one which has a high shut-off power as illustrated in Fig. 16, or anything between these types. While in Fig. 15 the (P-Q) or (bhp.) curve is of the overloading type with a decrease in head and *increase* in capacity, the (P-Q) or (bhp.) curve shown in Fig. 16 is of the overloading type with an increase in head and *decrease* in capacity.

While pumps with non-overloading power curves are advantageous because the driver is not overloaded under any operating conditions, they are not obtainable in all specific speed types of pumps. The actual range in

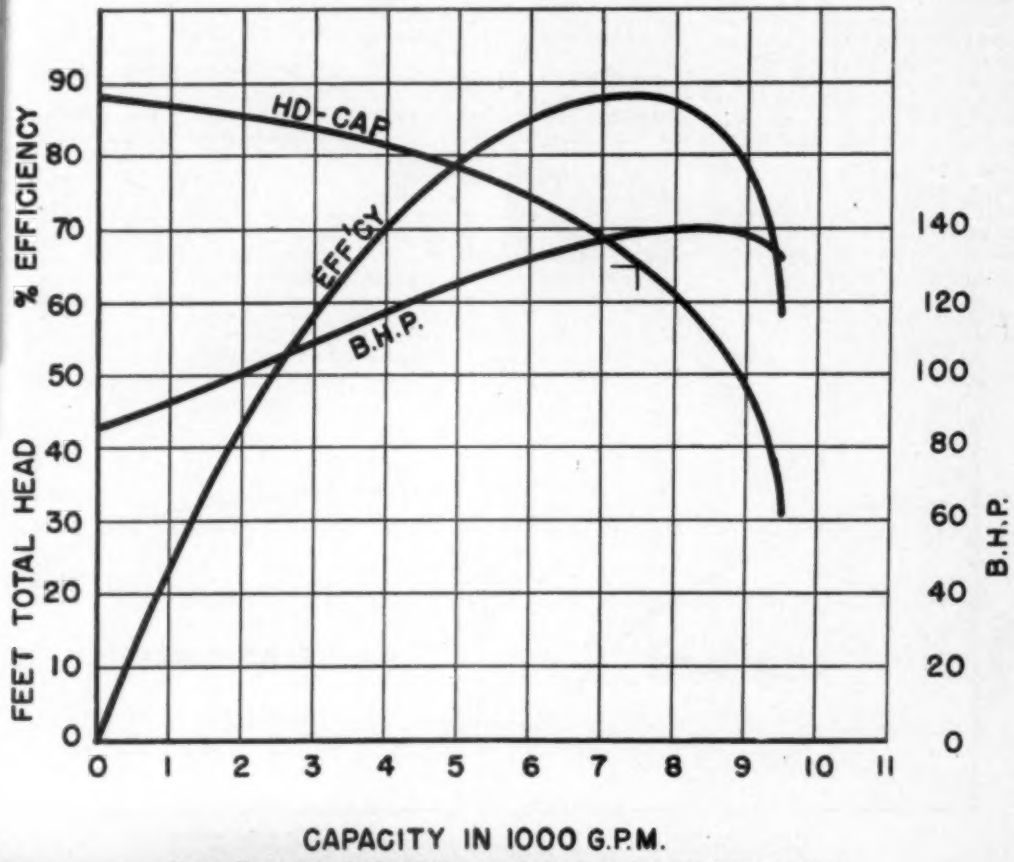


Fig. 14—Characteristics of a Pump With Non-overloading Power Curve With Reduction in Head

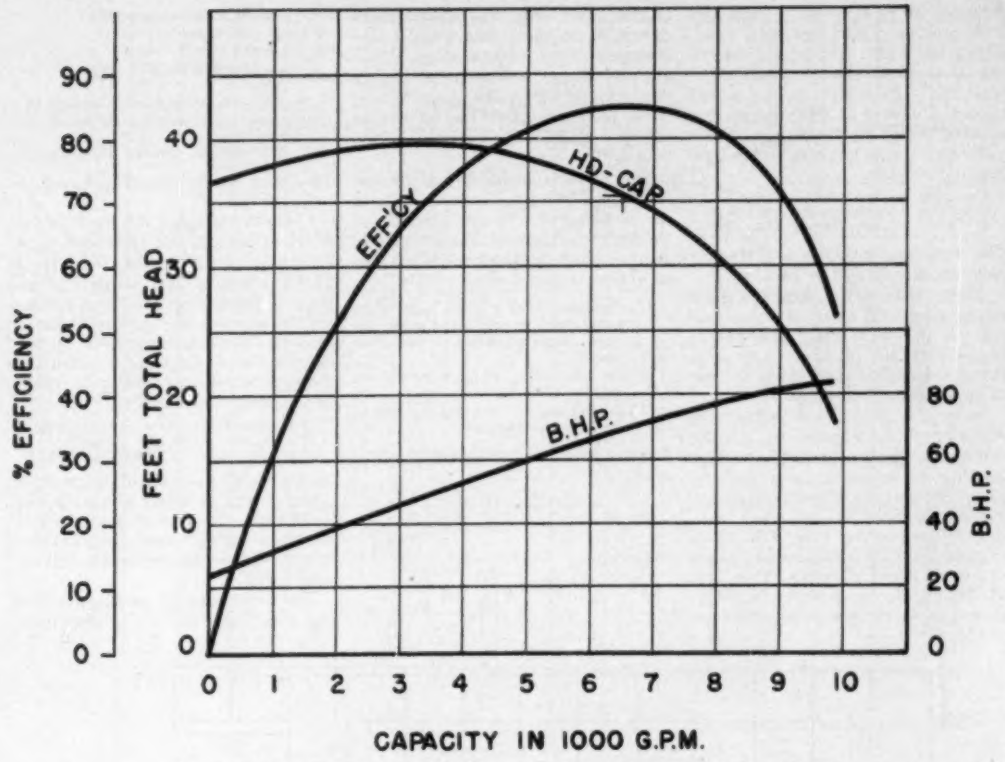


Fig. 15—Characteristics of a Pump With Overloading Power Curve With Reduction in Head

operating conditions to be encountered in the operation of a pump determines the range in power requirements and the driver size should be selected for the power demand to be encountered.

Mathematical Relations of Head, Capacity, Efficiency and BHP

The useful work done by a pump is naturally the weight of liquid pumped in a period of time multiplied by the head developed by the pump. This is generally expressed in terms of horsepower and is called "Water Horsepower." It can be determined by the relation,

$$WHP = Q \times H \times \frac{\text{specific gravity}}{396^{\circ}}$$

where

Q = pump capacity in GPM.
H = total head in feet.

The power drive required to drive the pump is regularly determined in horsepower and is called the (bph.) input to the pump. The ratio of the (whp.) output to the (bhp.) input is the pump efficiency. The relation between (bhp.), capacity, head and efficiency is therefore:

$$BHP = \frac{Q \times H}{\text{efficiency}} \times \frac{\text{specific gravity}}{396^{\circ}}$$

Type Characteristics

If the operating conditions of a pump at the design speed, namely, the capacity, head, efficiency, and power input at which the efficiency curve reaches its maximum, are taken as the 100% standard of comparison, the head-capacity, power-capacity and efficiency-capacity curves can all be plotted in terms of the percentage of their respective values for the capacity at maximum efficiency. Such a set of curves represents the "type characteristic" or "100% curve" of the pump. Fig. 17 shows the type characteristic of the pump whose performance is shown in Fig. 12.

Centrifugal Pump Relations

There are certain relations whereby the performance of a centrifugal pump can be predicted for another speed than that at which the pump characteristic is known. There are also certain relations whereby we can predict the performance of a pump if the impeller were to be cut down in diameter (within a limit depending upon the impeller design) from the characteristics obtained at the larger diameter.

When the speed is changed:

(1) the capacity for a given point on the pump characteristics varies as the speed, *while at the same time*
(2) the head varies as the square of the speed, and
(3) the brake horsepower varies as the curve of the speed.

Putting these relations in the form of equations, we have

$$Q = Q_1 \times (n/n_1)$$
$$H = H_1 \times (n/n_1)^2$$
$$P = P_1 \times (n/n_1)^3$$

or

$$\frac{n}{n_1} = \frac{Q}{Q_1} = \sqrt{\frac{H}{H_1}} = \sqrt[3]{\frac{P}{P_1}}$$

where—

n = new speed desired in R.P.M.
Q = capacity in G.P.M. at desired speed n
H = head in ft. at desired speed n for capacity Q
P = brake horsepower at desired speed n at H and Q
n_1 = speed in R.P.M. at which the characteristics are known
Q_1 = a capacity at speed n_1
H_1 = head at capacity Q_1 at speed n_1
P_1 = brake horsepower at speed n_1 at H_1 and Q_1

On Fig. 18 there is plotted the 1800 rpm. characteristics of a pump which

indicates at that speed it produced 2600 gpm. at 210.2 feet total head, taking 162.5 bhp. and having 84.9% efficiency. If we desire to obtain the 1600 rpm. characteristics, we would correct a number of 1800 rpm. points to 1600 rpm. The 2600 gpm. point mentioned would be corrected to 1600 rpm. as follows:

$$H = 2600 \times (1600/1800) = 2311 \text{ GPM}$$
$$Q = 210.2 \times (1600/1800)^2 = 166.1 \text{ ft.}$$
$$P = 162.5 \times (1600/1800)^3 = 114.1 \text{ BHP}$$

The resulting 1600 rpm. characteristics are also shown in Fig. 18.

These relations for change in speed can be used with safety for moderate changes in speed. They may not be found accurate in case of a large change in speed, particularly in case of an increase in speed.

It is also possible to reduce the diameter of the impeller by actually cutting it down in a lathe. The average impeller can be cut down in diameter about 20% of its original maximum diameter without adverse effect. Cutting it down to less than 80% of its original diameter will generally result in a much lower efficiency. This limit of 20% is of course merely approximate as some designs of impellers can be cut more than this, while others cannot be cut more than a small percentage without adverse effect. Actually any change in diameter will affect the proportions of the impeller and some variations from the theoretical results should be expected when tested.

It is found if an impeller of a suitable design is cut in diameter that, at the same speed, the characteristic of the pump will have a definite relation to its original characteristics or closely so. These relations are:

(1) the capacity for a given point in the pump characteristic varies as the impeller diameter, *while at the same time*—

(2) the head varies as the square of the impeller diameter, and

(3) the horsepower varies as the cube of the impeller diameter.

Expressed in form of equations, these are:

$$Q = Q_1 \times (D/D_1)$$
$$H = H_1 \times (D/D_1)^2$$
$$P = P_1 \times (D/D_1)^3$$

or

$$\frac{D}{D_1} = \frac{Q}{Q_1} = \sqrt{\frac{H}{H_1}} = \sqrt[3]{\frac{P}{P_1}}$$

where

D_1 = original diameter, (inches)
D = cut down diameter, (inches)
Q_1 = capacity with D_1" impeller
Q = corresponding capacity with D" impeller
H_1 = head with D_1" impeller at capacity Q_1
H = corresponding head with D" impeller at capacity Q
P_1 = BHP with D_1" impeller at capacity Q_1 and Head H_1
P = BHP with D" impeller at capacity Q and head H

Considering again the same pump which at one point at 1800 rpm. gave 2600 gpm., 210.2 ft. tdh., 162.5 bhp., 84.9% efficiency and which had an impeller diameter of 14¼" and assuming the impeller was cut to 14" diameter, the corresponding point on the characteristics of the pump with a 14" diameter impeller at 1800 rpm. would be determined as follows:

$$Q = 2600 \times (14/14.75) = 2468 \text{ GPM}$$
$$H = 210.2 \times (14/14.75)^2 = 189.4 \text{ ft.}$$
$$P = 162.5 \times (14/14.75)^3 = 139. \text{ BHP}$$

Doing this likewise with a number of other points, sufficient points on the 1800 rpm. characteristics of the 14" diameter impeller could be obtained to permit drawing the curves making up Fig. 19.

The most common problems utilizing these relations are to determine

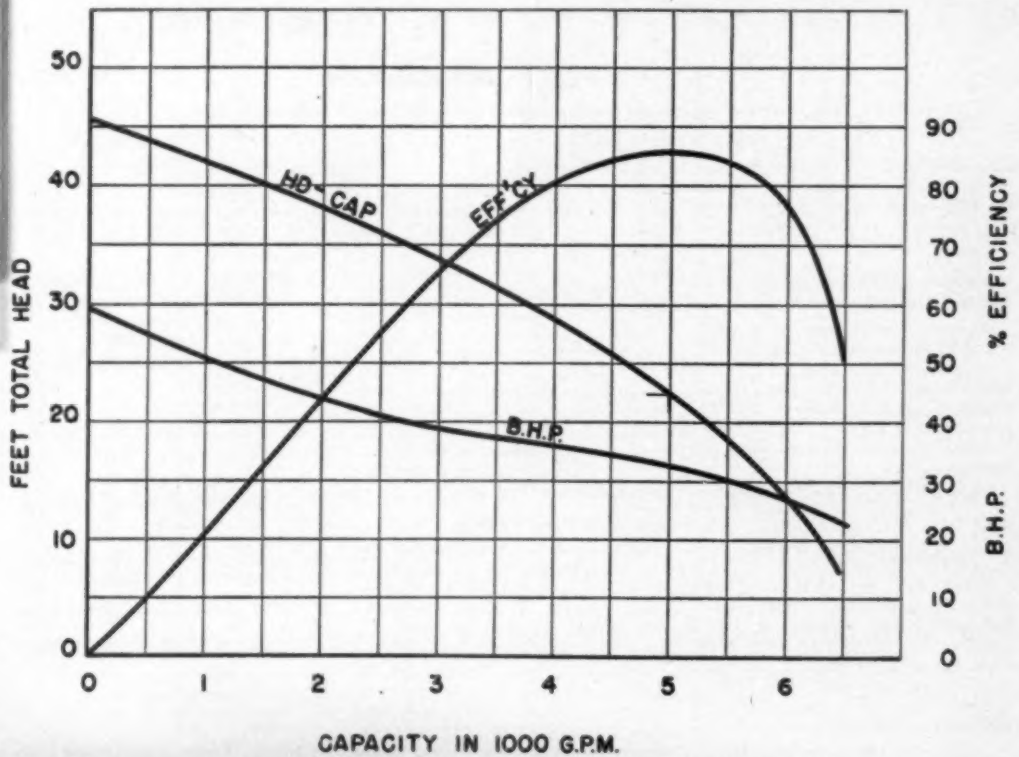


Fig. 16—Characteristics of a Pump With Overloading Power Curve With Increase in Head

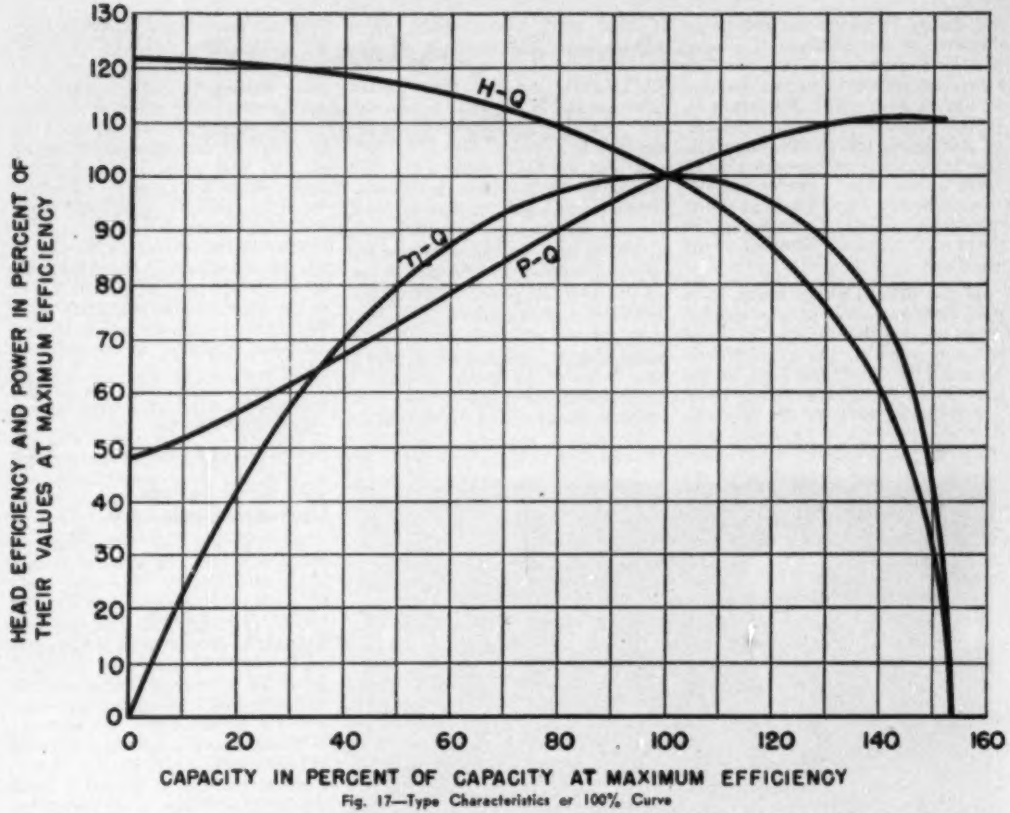


Fig. 17—Type Characteristics or 100% Curve

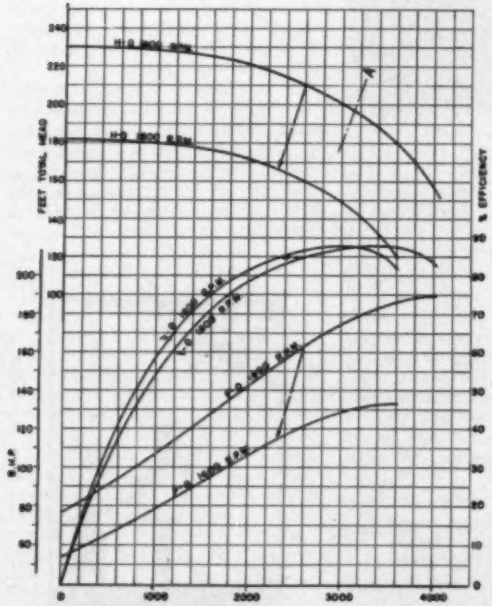


Fig. 18—Effects of Speed Charge on Pump Characteristics

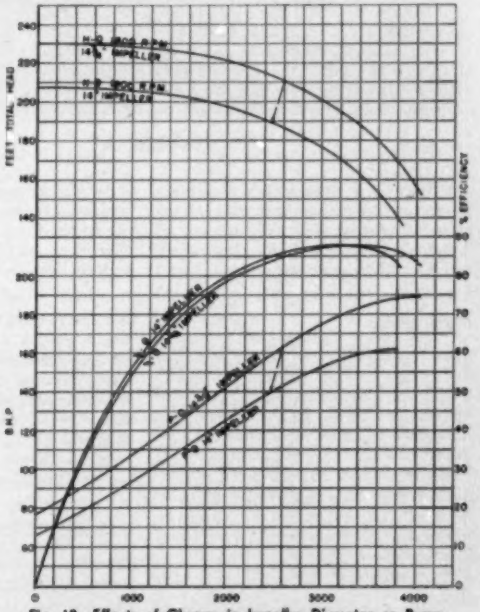


Fig. 19—Effects of Change in Impeller Diameter on Pump Characteristics

the change in speed, the change in diameter of the impeller, or a combination of both necessary to produce a head-capacity characteristic passing through a given point. For example, suppose we have to meet the condition of 3000 gpm., 180 ft. tdh. Since this falls below the head-capacity (H-Q) curve of the 14¾" impeller at 1800 rpm. shown on Fig. 18 we can obtain the desired (H-Q) by reducing the speed or reducing the diameter of the impeller.

If the desired pump which is to give 3000 gpm. 180 ft. was speeded up or the impeller diameter increased so that point on the characteristic became 3100 gpm., the head, at the same time, would have become 180 x $(3100/3000)^2$ or 192.2 ft. Similarly if 3200 gpm. was obtained by a further increase in speed or impeller diameter the head would be 180 x $(3200/3000)^2$ or 204.8 feet. Plotted as shown in Fig. 18 these form a section of a curve (A). This intersects the 1800 rpm. (14¾" D_2) H-Q characteristic at 3135 gpm. 196.5 feet indicating the point on that characteristic from which we have to work. Now if we are to obtain 3000 gpm. at 180 ft. tdh., we can determine the required speed by calculation of 1800x(3000/3135) or by 1800x$(180/196.5)^{1/2}$ both of which give 1723 rpm. Should it have been that no speed change was desired, it would have required a diameter change of 14.75 x (3000/3135) or 14.12". Had the new driver run at 1760 rpm. the 14¾" diameter impeller would have given 3065 gpm. 187.9 feet tdh. requiring in addition a cut in the impeller diameter to 14.44". In all three cases a new curve which would pass through 3000 gpm: 180 ft. tdh. can be plotted by stepping down a number of the 1800 rpm. 14¾" diameter curve points, the capacities being reduced by the ratio of (3000/3135) with the corresponding heads being reduced by the ratio of $(3000/3135)^2$ and the corresponding bhp.'s being reduced by the ratio of $(3000/3135)^3$ or the bhp.'s can be calculated from the resulting capacity and head and the pump efficiency at the point in question.

(The next article in this series will deal with model pumps, specific speed and rating curves and charts.)

Exhibit "A"

Where more appropriate could *water*-melons be grown than at a water-plant? Right beside the front door of Atlanta's Filtration Plant this volunteer vine delivered the goods. No. 1 water-melon man in the water-works business, pointing to the melons, is Sherman Russell, Atlanta Supt. of Filtration and Chairman of the Southeastern Section of A.W.W.A.

16th Illinois Sewage Operators Conference

Meeting for the 16th time in Springfield, Ill., the Illinois Sewage Treatment Works Operators held their annual conference on Mar. 29 and 30. Included on the program were discussions of treatment works operation from the standpoint of inexperienced operators, and from the standpoint of experienced operators. Prof. H. E. Babbitt of the University of Illinois gave a talk on Industrial Wastes; Prof. L. H. Kessler, Northwestern University, headed a panel discussion on "How would you design a sewage treatment works?" Participating were consulting engineers, operators, superintendents, and health department representatives.

C. C. Larson, Chemist, Springfield Sanitary District, moderated a panel discussion on "Preparation for A Material Shortage Emergency." The meeting concluded with a talk on "Biology of Stream Pollution" by R. H. Shiffman, Biologist, State Dept. of Health.

Hydrology

John Wiley & Sons, Inc., New York, N.Y., have published a book titled "HYDROLOGY," by C. O. Wisler and E. F. Brater. This book presents the fundamental principles of hydrology as they have been developed up to the time of writing. The unit hydrograph, the theory of infiltration capacity, and many other recent developments in this field are presented in a clear and understandable manner. Practical examples are given for their use.

This engineering book discusses: the hydrograph — its characteristics and the factors that affect it; precipitation—its causes, frequency, intensity, and methods of disposal; the long term average and low water yield of drainage basins and wells; floods—their causes, frequency, and possible methods of relief; the unit hydrograph infiltration capacity, and other recent developments.

The authors list additional references and the book is supplemented by tables, diagrams, and numerous explanatory illustrations.

The book consists of 419 pages and may be obtained from John Wiley & Sons, Inc., at $6.00 per copy.

It's Spring Again!

Hon. Member A.W.W.A.

Headaches, Hunches and Hard Work

Pages from the Life of a Superintendent

*(Sixth Installment)**

by M'KEAN MAFFITT, *Retired Sup't. of Water & Sewage Works, Wilmington, North Carolina*

"HOW do you explain this water bill?"—Ever hear that?

Well once in a long while we run across a person who is really a reasonable and sensible person. Then, too, we run across some who have no reason at all. In the first category it was a male customer who came to the office one day to pay his water bill and requested information. He proceeded by throwing his water bill notice down upon the desk with the demand, "Can you explain this water bill?" When I told him that I could not do so until I had made an investigation, he replied "Damn right you can't, and you had better not try. Its none of your business whether the wife is washing the baby's backside or her own. If you could explain that bill without making an investigation I would shoot your heart out. But, since you are a nice man, will you not make an investigation and see if you can determine how I use or waste so much water?" Of course we did everything possible to determine the cause, and we did.

In the second category it was a mechanic. He was foreman of a small industrial plant and he was supposed to be at least partially reasonable in his mental activities. He requested an explanation of the large amount of his water bill and when I told him that I could not offer an explanation until I had had an investigation made of the conditions he got extremely wroth. He was of the opinion, that being superintendent, I could explain anything that happens within the premises of the 10,000 customers whom we served. He said that if I could not make an explanation without an investigation I ought not to be holding the job of superintendent. I tried very carefully to explain to the man that I did not even know where he lived, how many chickens he had, how many children, whether or not he sprinkled his lawn; nor, did I know what the general surroundings were. I even went so far as to tell him that at that exact moment, nor at any other for that matter, did I know whether his wife was washing the baby or washing vegetables and that it was none of my business; but that only after an investigation of the conditions could I offer any explanation whatsoever, even if then. I told him that I did not even know where he lived, what kind of house, how many rooms, fixtures, nor how many people used the water. Still he insisted that I should know all that was to be known about the intimate uses of water that may take place at his home. I never satisfied him and even today he looks at me with a jaundiced eye when he meets me on the street.

> This is one of a series of "short-stories" by a Water Works "Super," who claims that he learned all that he knows about the water works business "the hard way."
>
> We have frequently listened with much pleasure to the philosophy and reasoning of the author, as expressed on the floor of water works meetings and privately. And, we have heard him "preach" a lot of common sense to the younger men and newcomers in the water works business.
>
> If you have missed any of the earlier articles of this series by M'Kean Maffit go back and read them.*

How Not to Determine Valve Locations

In Wilmington, at that time, we had a system of measurements for valve locations that we found to be woefully in error. In the case of valves on hydrant branch lines we measured from the face of the hydrant to the location of the valve; thus in peace-times we were able to locate these valves without any trouble, but "peace" does not always reign in the Water Department. One day a bootlegger in a Ford was running whiskey and the cops were chasing him. In his endeavor to escape the clutches of the law he attempted to round a corner at too great a speed and instead of making the turn he picked up a hydrant and carried it a considerable distance down the street. Since the hydrant was broken off just below the boot-flange it left a wide open break for the escape of water. Immediately there was a fountain of water that flooded the street and adjoining property. As soon as I could get to the job I made an effort to measure the necessary distance to the valve, but since the hydrant was no longer there, but a lot of water was, the measurement was just a little difficult. However, since it would have been necessary to close two twelve inch and several smaller valves to stop the water flow, I thought that maybe I could find the valve box even though it was covered by about six inches of flowing water and sand. The street was paved with brick without grouted joints and I believed that I might be able to feel around the bricks at about where I thought the valve was, and thus locate it before the valves on the supply main could be closed. Therefore I got down on my knees and crawling around in the water began to feel my may along. Since this happened in a business section of the city there were a great many "sidewalk-superintendents" present who very kindly gave me advice as to how to proceed. In fact there were several bets made as to how soon I would drown, how soon I could find the valve, etc. And, also there were several statements as to my mental stability.

*Earlier installments are to be found in issues of March, April, July, Sept. and Dec. 1950.

One wise guy said, "Looks just like a cooter (turtle to you), don't he?" I felt like one too, but I managed to find the round edge of the valve box, opened it and shut the water off before the gang had made any great progress at closing the main valves. Then I had the pleasure of hearing one man say, "Well he may look like a cooter but he seems to know his onions," just as if onions grew in free flowing water from a broken hydrant.

After this experience we made measurements to hydrant branch line valves not alone from the face of the hydrant for "peacetime" use, but also from permanent objects, such as curbs, buildings or other unwashable locations, for use when wild drivers hit hydrants and carried them away from the places where they once were. Later we had three other hydrants knocked off and the new system of measurements worked very nicely. One case was where a lady, learning how to drive, decided to try a hydrant instead of a telephone post; the second was where a box-car jumped the track and attacked a hydrant, with dire results. In this case the street department had slushed asphalt over the street in making repairs and had we not had the proper measurements we would have been lost unless a dipping-need valve box locator would have solved the problem. The third case was that of a negro man who said that he must have been asleep at the wheel because when he woke up he "was a settin' in his Ford with the water jess a bilin' up under him."

Some Chickens That Didn't Hatch

Some time after the beginning of World War II, when our pumpage was rising at a too rapid rate, we had another seige of salt water intrusion up-stream. The Council authorized the installation of pumps at several deep wells in the city. Of course we knew that these wells would not furnish sufficient water for the city, but the calculated 2,000 GPM we thought we could get out of them would materially reduce the chloride (salt) content of the total supply and make it at least fit for use if nothing else. We gathered information about all the wells as to size, location, capacity and what not, that were in the city. We decided to use 4 wells that promised good results. Motors and pumps were bought, installed and started. Each pump was of capacity that would fit the reported yield of the well upon which it was to be placed. In each case the well water was used by the owner for cooling purposes only, and we could quite easily arrange suction lines so that we could get all of this heretofore wasted water and pump it into the mains after chlorinating.

Of course the wise guy sometimes makes a terrible mistake and goes off half cocked. I had told the Commissioner that I believed that the four wells would solve our troubles unless the chloride content of our regular surface supply got above the then 2500 p.p.m. chloride content. But, I had counted my chickens before they were hatched, and I found that upon actual delivery test we were getting from all of the wells only some 900 GPM, which was so little that it was hardly worth while operating them. But, as in so many other cases, mother nature came to my rescue and it rained and flushed the salt water down stream from the intake. This particular seige of salt was over, but later the salt came back and the conditions were just as bad as they had ever been before.

When the war effort became a full rated procedure we had more than just one hell of a time. What with the war expansion our pumpage ran to such peaks that we could not keep the pen on the chart. The demand for water was so great that we could not meet it. War camps, shipyards, housing, laundries, trailer camps and many others demanded water and more water. Government funds flowed like water from a burst main; then, just ran everywhere. Mains were placed on paper because it was so easy to lay down a line with a pencil, but they did not fit when it came to placing that line on the site.

Everything Grew Faster Than the Supply of Water

Water mains, sewer lines, house services and more and more users sprang up like Jonah's gourd. In one case a government supported housing job was installed. For some 500 apartments the plans called for, and there was installed, no less than a 10" Protectus meter on the supply line. This was supposed to connect to either the City's supply or to a private supply nearby. The City's lines were some mile away, so the connection was made to the 4" line of the private supply that had a reported capacity of some 150 GPM when that much was available, which was not often. Of course even less than this amount continuously, with a storage tank, would have been sufficient; but, since at the time of greatest demand there was only some 100 GPM that the 4" line could supply, the occupants of these apartments took just what water they could get, if they could get any at all. At a later date all of this was taken onto the City's lines and everybody was happy.

We were unable to get materials despite the fact that the government had practically forced us to take on these new consumers. We would get wise to the receipt of materials by a local supply concern and would request that they hold, say, six 2" brass gate valves for us; but before we could get to the supply house an Army purchasing agent would get there, see the valves, order them delivered to his truck, with the comment that he might need them later. The army man, upon being informed that of the 24 valves the supply concern had received we had ordered 6 of them, he said, "Let the City hunt for its materials. I have the power, therefore I will have the valves."

There are many other instances of Army Purchasing Agents crippling the ordinary operations of local utilities simply because they had the power. Then the red tape that was used in the governmental service, had it been reeled up and put in usable order it would have reduced the nation's wrapping string demand by nearly one half. In this connection there is the story of a citizen who, having bought a large number of different size wrappers and stamped envelopes, needed a piece of string to tie up his purchases. He requested the clerk for a piece of scrap string, plenty of which was in the trash basket at the side of the clerk's desk. The clerk told him that he was sorry, but that regulations did not allow him to give away, even a scrap of string from the trash basket. "Then, maybe you could give me a piece of red tape," said the citizen. Needless to say, he got the piece of string. So many governmental regulations were so designed that many superintendents developed ulcers, and many other kinds of troubles, what with the worry that they were needlessly caused by rules made to fit one exact case but applied to all cases that bordered on the one.

One further illustration will do to cover this. I tried to buy certain nipples of Byers Wrought Iron pipe. I was informed by the salesman that he had none available. He had just sold their entire supply to one army camp and at a navy camp within 20 miles of the army camp he found that there were hundreds of barrels of assorted nipples, exactly duplicating the order just given him by the army. This method caused prices to soar, minds to go blank, hair to turn gray, heads to get bald and

many other greater, as well as smaller, aberrations among the long suffering superintendents and operators.

There was another practice that the government used to worry the superintendent. This amounted to many nights of worry and many hours of wasted effort because of the lack of governmental co-ordination. At the very beginning of the war one bureau at Washington called for a complete map of the distribution system so that the necessary steps could be taken to prevent catastrophe in case of air raid or other disruption of service. That in itself was fine, but unless the superintendent had a complete set of maps on tracing cloth he had a job. Almost as soon as I had placed one set of maps in the hands of the Army, the Civilian Defense Dept., came along and asked for another set. Soon thereafter another bureau called for a set of such plans. Then along came a Colonel, making a detailed survey of the entire plant, production and distribution. He also wanted a set of such plans. They were furnished, but not with any pleasure. Hardly had this Colonel left the city before another "survey" from another department called and he too wanted a set. In fact I furnished four or five different sets of distribution main plans and I yet do not believe that either the Army, the Navy, the Civilian Defense Dept., nor any of the other bureaus in Washington could place their hands on either one of the sets. Probably they are filed away in the archives where they will remain until time, or termites, destroy them.

A Peculiar Accident

We had one very peculiar accident, unbelievable except that I saw and experienced it personally. A telephone call on day from the most prominent men's club in the city informed me that the electric cable duct in the basement was flowing water. Inspection revealed that it was the truth. The end of a 1½" galv. duct was flowing water into the basement. Examination of all the known water services in the neighborhood failed to reveal the cause. Continued questioning of the custodian of the building revealed the fact that a few minutes before the discovery of the inrushing water their electric power had been interrupted. It seems that an army truck had collided with a telegraph pole some 75 feet away from the club building, tearing down an electric cable duct when it hit the pole. Immediately thereafter, or coincident thereto, the electric power had been shut off. Inspection of the pole and duct revealed the fact that there was a power cable coming from the high voltage line at the top of the pole, which entered a duct at about 9 feet above the sidewalk. This duct then ran below the surface of the street, apparently to the club building. The electric cable in the duct had been broken, the duct burned considerably before the shortage in the current blew the proper protective appliances. In the meantime the basement of the club was gradually filling with water. Looking over the ground conditions I found that there was an abandoned water lateral at a double store building next to the club. Digging up this abandoned lateral we found that the power cable duct was immediately above and lying on the old water lateral pipe, but there was no sign of water, though we could get the sound of flowing water with an ear phone. Looked hopeless at first, but going one step further I had the duct pryed away from the water pipe. Immediately there was a run of water at the point of contact between the two pipes. The water than ceased to flow into the basement of the club, it was flowing into the hole around the two pipes. Cutting out a piece of the water pipe, but leaving the duct for the power company to attend, we found that when the current had hit the duct from the shortage on the nearby pole it had arced to the water pipe, burning a hole in both the duct and the water pipe, thus allowing the water to escape. However, to make the unbelievable portion of the story, the heat generated had also welded the water pipe to the duct with sufficient efficiency to prohibit the flow of water outside, but confined it to the power duct. Thus the power duct acted as a conveyor for the water into the basement of the club. "Believe it or not."

After these, and many other extraordinary experiences, I had developed so many stomach ulcers that I was practically dead, but didn't have time to discover it.

At about this time we finished the extension of the new intake line the 22 miles up the river and the successful accomplishment of continuous effort over a period of some 22 years was in sight. The job was finished, the pumps installed and a Monday was set as being the day upon which the consulting engineer and I were to make the final inspection of the plant before acceptance. It was too much. The relief was too great. On the Sunday preceeding the Monday set, my stomach, as so many times the mains had done before, burst and I had a hemorrhage from an ulcer. I went to the hospital, had the offending member removed, but not a new one substituted, and for a number of weeks I was neither dead nor alive. Twenty-five pint transfusions of blood and plasma, making me really a member of The United Nations, since I got German, English, Irish, Hebrew, American and maybe some African blood, along with some excellent nursing and doctoring brought me back to where I could stand alone and eat a little, smoke a little and drink a little. I figured that it was now about time for me to retire. I did, and now live the Water Works field in retrospect.

Homemade Repairs on Patented Machine Parts Unlawful*

According to the law, you as an owner of any kind of machinery, have no legal right to make repairs on the portions of such machinery that are patented. Perhaps you *have* paid in full for the machinery. Perhaps it *is* legally yours. But that makes no difference in the eyes of the law when it comes to repairing or replacing patented parts. You may break or completely destroy the patented parts if you feel like doing that. Ownership permits destruction but it does not permit building up of machine parts that are patented by law.

Patents often apply only to specific parts. You may do whatever you wish with the unpatented parts, of course. But the patented portions must not be repaired by you or anybody else without the permission of the patentee. Anybody furnishing parts for patented portions or repairing those parts who is not licensed by the patentee to do so is subject to damage for infringement. True, the infringer may not be molested, but he "takes a chance."

*Contributed by W. F. Schaphorst, M. E., Newark, N.J.

Figure It Out

Anyone who drinks a glass of our city water every morning for 1200 months, will live to see his 100th birthday. We guarantee it!

Incinerator Installation at Cleveland's Southerly Plant

Sewage Treatment Plant Equipment

Multiple Hearth Incinerators

*The Sixth Article of a Series**

by FRANK L. FLOOD, *Partner, Metcalf & Eddy, Boston, Mass.*

A CONSIDERABLE number of multiple hearth sludge incinerators have been installed in the United States, the larger installations being at Detroit, Minneapolis-St. Paul, Cleveland, and Columbus. Representative smaller units include those at New Britain and New Haven, Conn.; Wyandotte, Mich.; Ashland, Piqua, and Barberton, Ohio; and Elmira, N.Y. All of these units were manufactured by the Nichols Engineering & Research Corp.

The Martin multi-zone furnace, presently manufactured by Morse Boulger Destructor Co., has been installed for sludge incineration at Raritan and Rutherford, N.J.; Lansing, Mich., and Wisconsin Rapids, Wis. At present only the Lansing unit is in operation and that for sludge drying. Similar units have been installed for incineration of screenings at Niagara Falls, N.Y., and Milwaukee, Wis.

*Other articles in this series appeared in May, June, August and October, 1950, and March, 1951.

Design Features

The multiple hearth furnace consists of a cylindrical shell mounted on columns supporting hearths one above the other, the shell lined with a wall of insulation and firebrick.[1] A vertical air-cooled central shaft revolves and turns horizontal arms above each hearth. Teeth attached to these arms continually stoke or rabble the sludge so that it moves progressively downward through the furnace. When designed as an incinerator, hot gases produced by the burning of volatile matter in the sludge, or from supplementary fuel such as oil or gas, pass upwards through the furnace in counter current to the sludge.

Special provisions are advisable if the multiple hearth unit is to provide for both incineration and drying. In addition to the method above described while operating as an incinerator, provision should be made for burning oil or gas over the upper hearths and drawing the hot gases down through the furnace parallel with the travel of the sludge.

The Nichols Multiple Hearth Unit at Dayton, Ohio, has been operated in this manner as a drier since 1939. Digested sludge partially dewatered on sludge-drying beds is further dried to below 8 per cent moisture for sale as fertilizer. Sludge gas burns on the upper hearths and supplies the heat for drying.

At the Toronto Ashbridge's Bay plant two multiple hearth units designed to either incinerate or dry sludge cake, and with a unit capacity to evaporate 12,000 lb. of moisture per hour, have been contracted for. Provision will be made in connection with these units to mix a portion of the dried sludge removed from the bottom hearth with the filter cake before the latter is admitted to the top hearth.

In the following text the writer has summarized operating experiences with multiple hearth units at a number of sewage treatment plants, based upon personal observations,

[1]Recent refractory hearths have been cast in place in certain locations within the incinerator units. There are indications that this type of hearth is more satisfactory for some hearths than those made of individual firebrick blocks.

published reports, and comments by the plant operator. The observations presented should not be construed as criticism of designers, manufacturers, or operators. It is the intent to record difficulties which have been experienced, measures taken to improve conditions, and to record operating results so that others facing similar problems may profit thereby.

Detroit.

The largest installation of multiple hearth sludge incinerators is at the Detroit sewage treatment plant. There are four units each 22 ft. 9 in. outside diameter with 12 hearths as initially installed and a rated capacity of 330 tons of sludge cake per day. The initial plant included preheaters designed to use the hot gases leaving the incinerator to preheat the air used for combustion. In actual operation, the heat value of the volatiles in the raw sludge under normal conditions of operation have been more than sufficient to support combustion. The operation of the preheaters was not necessary and in fact not desirable.

Operating difficulties with the incinerators at this plant disclosed the necessity for a number of changes in methods, equipment, and appurtenances in order to obtain best results.

In the operation of the Detroit incinerators, it has been found that excessive temperatures caused damage to the equipment and low temperatures caused excessive smoke in which case the burning of large quantities of fuel oil would be required to correct the situation. An important operating feature has been the control of the feed to prevent sudden changes, particularly in the amount of grit and screenings. The problem created by the screenings disposal was in large measure solved by grinding and returning them to the sewage flow. Until recently, it was not practical to dispose of all the grit removed at the plant by incineration. However, changes now being made which include grit storage and feed by means of screw conveyors at a uniform rate from the storage hopper to the conveyor belts discharging to the incinerators should make it practical to incinerate all of the grit with a minimum of operational difficulty.

The initial reciprocating plate feeder on several of the individual incinerator units has been replaced with a variable speed ribbon conveyor and storage bin. This change is reported to have resulted in the elimination of smoke leaks, better and more uniform distribution, and less violent temperature changes.

Some rabble arms are of 12 percent chromium and 12 percent nickel, others are of Nercaloy. The rabble arms of 25 percent chromium and 12 percent nickel must be insulated in the combustion zone in order that they may have reasonable life. Replacement of rabble arms has been greatly reduced since temperatures have been controlled at under 1,600 deg. F. for most of the time. Temperatures are controlled by allowing cool air to enter the furnaces through the hearth doors and by regulation of butterfly dampers in the enlarged section of the ducts ahead of the stacks.

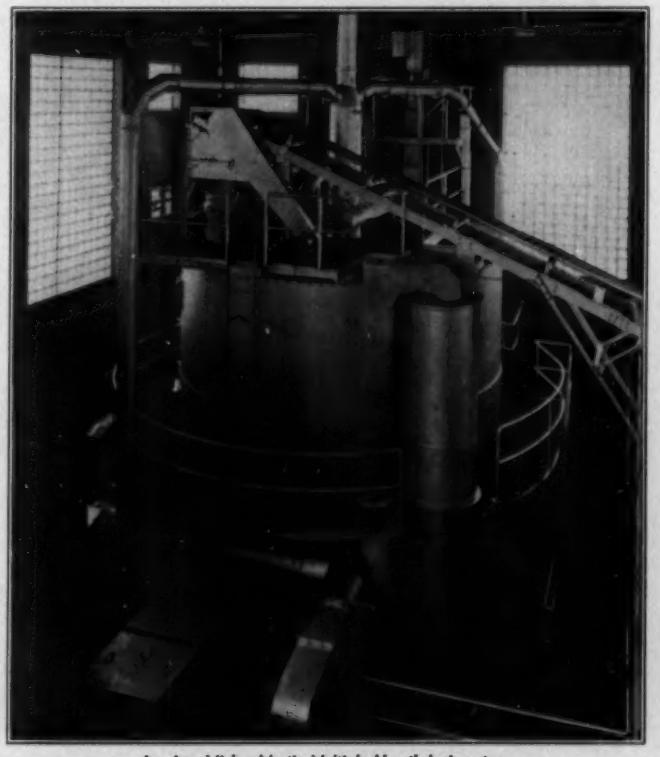
Weightmeter counters have been installed on the control board and also in the filter room to permit closer observation and control of the feed rates.

The linings in the steel stacks through which the vapors from the incinerators are discharged, as initially constructed, were not suitable for the temperatures encountered. Recently corrosion, reportedly caused by acids present in the flue gases, has been a serious problem at the inner faces of incinerator shells, breechings and stacks.

Improvements to incinerator No. 4 have increased its rated capacity to 14 or 14½ tons of sludge cake per hour. The normal working capacity for average monthly production is 12 to 13 tons per hour. This remodeled unit has 11 hearths and enlarged drop holes in the drying and combustion zones. The most important feature improvement to this unit was the additional flue capacity. A large number of lance holes were provided on out hearths to facilitate cleaning and to provide an abundance of fresh air. The latter is reported to be of importance to minimize slagging.

During 1949 the incinerators burned all of the 194,797 tons of filter cake produced at the plant, all of the 1,132 tons of scum removed from sedimentation tanks, and 99.97 percent of the 15,127 tons of grit removed from the grit chambers.

How unit loadings on multiple hearth incinerators may be best



Lansing, Mich.—Martin Multiple Hearth Incinerator

expressed is still a question. The interior diameter, number of hearths, net hearth area, volume for combustion, moisture evaporated, solids destroyed by incineration and ash handled, are important factors. Assuming adequate volume is provided for combustion per unit of hearth area, a unit of loading in terms of pounds of moisture evaporated and solids burned per square foot of net effective hearth area may have significance for purposes of making comparisons of performance between units at various plants. A test load on Detroit incinerator No. 4 resulted in the incineration of 14.31 tons of sludge cake per hour. This cake contained 36.41 percent solids and 52.08 percent volatiles dry basis. The moisture evaporated was about 9.1 tons per hour and the solids incinerated were about 2.7 tons per hour. The net hearth area of this incinerator is 2,500 sq. ft. and the load during this test per square foot of net area per hour was equivalent to 7.28 lb. of water evaporated and 2.16 lb. of solids incinerated, making a total of 9.44 lb. of water and volatiles. Including ash, the rate was 10.5 lb. per sq. ft. per hr.

The ash sluicing pumps have been taken out of a pit and installed at floor level to facilitate their servicing and maintenance.

As first constructed, the Detroit incinerator building was poorly ventilated. In the warmer months, the temperature in the upper operating gallery and under the roof was said to be over 130° F. and there was considerable odor of scorched sludge. Subsequently, four ventilating exhaust fans each of 40,000 cfm. capacity were installed on the roof of the incinerator building to exhaust smoke and gases and to improve conditions within the building.

Minneapolis-St. Paul.

There are three multiple hearth incinerators at this plant, each 22 ft. 3 in. outside diameter and with eight hearths. Each unit as provided had a rated capacity of 60 tons of dry solids per 24 hr., based on 65 percent moisture in the filter cake and 60 percent combustible matter in the dry solids. A fourth similar unit is under construction. Grit and scum are not burned in the incinerators.

The design assumed that supplementary fuel would be required for incineration of the sludge and that temperatures could be controlled by regulation of the feed of the fuel. However, it was found under practically all conditions of operation an excess of heat existed and no supplementary fuel was required.

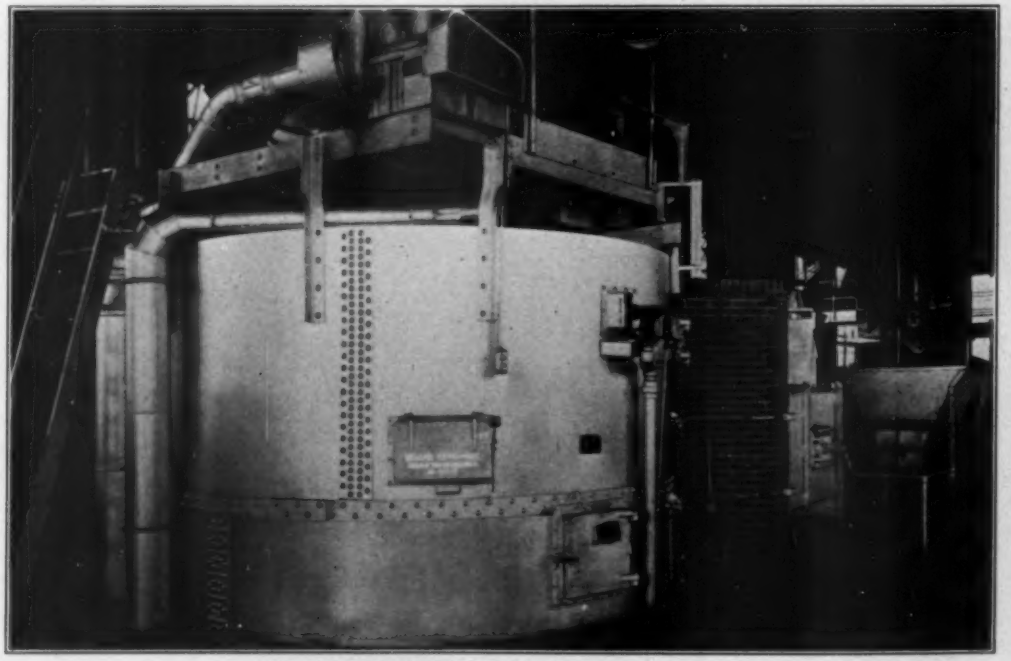
Instead of an anticipated maximum temperature of 1,600 deg. F. actual temperatures exceeded 2,200 deg. F.

The preheaters were removed from service with resultant reduction in power and maintenance costs.

It was found that if the feed rate was kept below 1.4 tons of combustibles per incinerator per hour excessive temperatures were practically eliminated. A chart was prepared showing safe rate of feed of filter cake to an incinerator unit for various percentages of solids and combustibles. The operators have found this chart very useful as a guide to operation.

The net hearth area is 2,084 sq. ft. per unit. The nominal capacity of each incinerator unit is equivalent to about 5.4 lb. per hour of moisture evaporated and solids consumed per square foot of net hearth area. On occasion, the units have been reported to satisfactorily handle an overload of approximately 33 percent. On the annual average the units operate at between 85 and 95 percent of the time.

Based on present rated capacity of 1.4 tons of combustibles per incinerator hour, the three incinerators for the past 2 years have averaged ap-

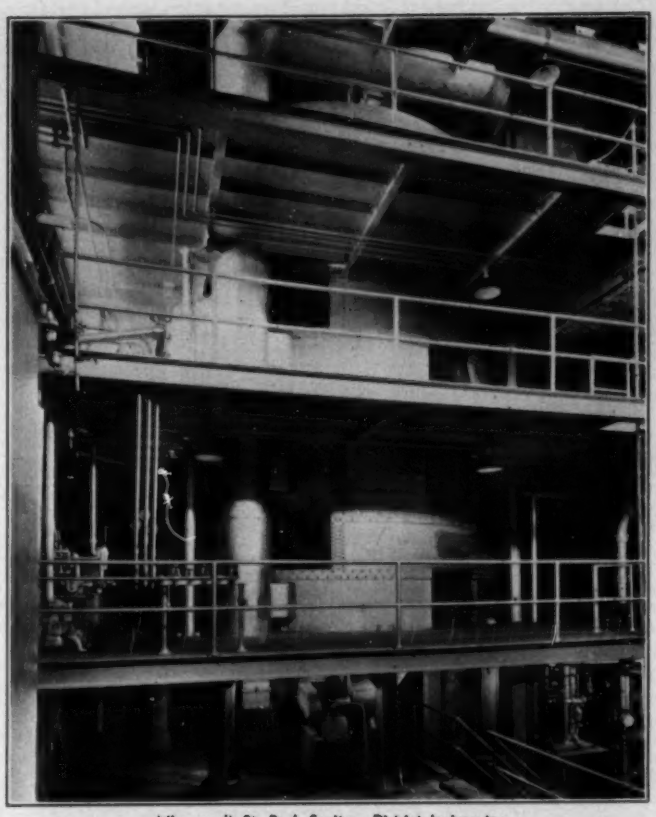


Milwaukee, Wis.—Martin Multiple Hearth Furnace for Screenings

proximately 72 percent of capacity. At numerous times during the year individual furnaces may be operated at near capacity for several days at a time.

Maximum temperatures of incinerators are kept below 1,600 deg. F. by operation of an induced-draft fan with variable-speed drive. The fan follows a duct in which water is added as necessary to keep the gas temperature at the fan below 700 deg. F. and protect the fan from damage by overheating. The speed of the fan is controlled from the main operating panel where the hearth temperatures are also recorded.

Ventilation in the incinerator building has been somewhat of a problem. Fixed glass blocks have been replaced by ventilating sash across one end of the building to supplement the three large ventilators placed in the roof. A wall fan has been added to cool a "dead" area in one corner of the incinerator. A similar fan is to be installed over the fourth incinerator now being built.



Minneapolis-St. Paul, Sanitary District Incinerator

Cleveland-Southerly Plant.

There are four multiple-hearth furnaces at this plant, each unit 18 ft. 9 in. outside diameter with eight hearths. The specified capacity per unit was 100 tons of digested sludge filter cake at 75 percent moisture content per 24-hr. day. In 1940, it was reported that these units could be operated at the average rate of 60 tons per incinerator day. In 1941, the capacity was reported to have been reduced to 50 tons per incinerator day. The inability to obtain design capacity was said to be primarily due to rapid accumulations of fly ash in the preheater passages. It was impossible to clean these passages with the preheaters in operation. On this account, the incinerators suffered from lack of adequate draft and a reduction in capacity.

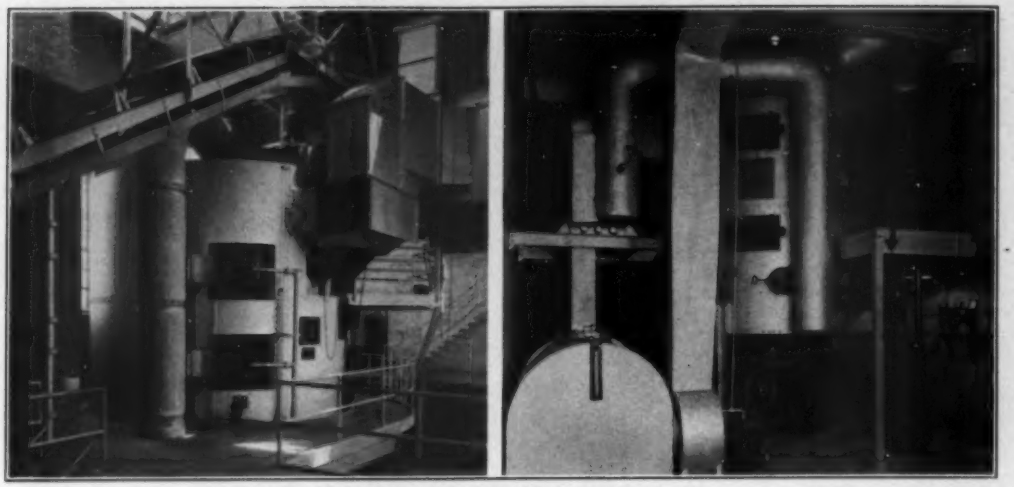
In 1942, three of the eight preheaters were eliminated, the other five cleaned and repaired, the combustion air ducts were enlarged, a bypass provided around the preheater units, gas boosters were added, and the number of gas burners was increased. Subsequently, the preheaters have been used infrequently. As a result of these changes, the unit incinerator capacity was increased to 80 tons of cake per day in 1943. The rate of operation with cake containing 31.9 percent solids of which 38 percent were volatiles was equivalent to 3.43 lb. of moisture evaporated, 0.60 lb. of volatiles consumed, and 4.03 lb. of moisture and volatiles per square foot net hearth area per hour. The average rate of operation in 1945 was 81.6 tons of cake per day per unit, the cake containing 28.4 percent solids of which 44.3 percent were volatile. The unit load in pounds of moisture evaporated and pounds of volatiles consumed was substantially the same as for the 1943 rated capacity as given above.

The multiple-hearth units at this plant were designed and initially operated on a somewhat different principle than those handling raw sludge at Detroit and Minneapolis-St. Paul. The top four hearths were drying hearths and are separate from the lower hearths. The hot gases from the combustion hearth beneath the drying hearth did not pass up through the upper hearth, instead they passed through the preheaters and thence up the stack. The gases from the drying hearth at a temperature of 500 deg. F. were passed through the preheaters where it was intended that they be raised to a deodorizing temperature of 1,200 deg. F. and then cooled down to about 500 deg. F. before being discharged to the stack.*

The preheaters are of the steel plate envelope type. As originally installed they were not suitable for the service. Dust and fly ash accumulated in the passages, greatly reducing their capacity and seriously limiting the output of the incinerators. The preheater units could not be cleaned without shutting down the incinerators and the cleaning operations were difficult to perform. In the operating reports, it is stated that the steel envelopes warped even though temperatures were kept within permissible limits. A portion of the preheaters were reported to have burned out during 1941.

Occasional operating difficulties reported include the slowdown or

*In 1942, after the incinerators were revamped, the method of burning sludge was on the same principle as at Detroit and Minneapolis-St. Paul.



Examples of Two Small Nichol's Multiple Hearth Incinerators
(Wyandotte, Mich.) *(Middletown, Conn.)*

partial interruptions by brick falling out of the hearth, by clinkering of the ash, and by burning out of the bag filters on the ash line.

In 1944 it was reported that considerable trouble was experienced with the warping of the rabble arms and teeth especially on hearths 5 and 6. The pyrocast arms which were used during that period were insulated with Kastset using nichrome wire as reinforcement to prevent warping. One ring of the refractory was removed from hearth 5. Eventually rabble arms on the lower or combustion hearths containing 25 percent chrome and 12 percent nickel were found to be satisfactory.

Theoretically all the vapors and gases discharged from the stack have passed through deodorizing temperatures. The stack extends only a few feet above the roof line and the wind currents from the bluff above the plant drive the vapors down to ground level. Observers have reported that at times a decided odor of scorched sludge has been detected in the vapors from the stack.

Ventilation in the incinerator building during the summer months has been reported as unsatisfactory. During this period, there is a tendency for the operators to spend as much time as possible out of doors.

Columbus, Ohio.

The multiple-hearth incinerator at Columbus has an outside diameter of 16 ft. 9 in. and has six hearths. It was designed to incinerate 80 tons per day of digested sludge containing 75 percent moisture and 12½ percent combustible matter wet basis. It is reported to have a capacity to burn 50 tons per day of digested sludge filter cake at 75 percent moisture and 50 percent volatiles dry basis. The net hearth area is 845 sq. ft. The reported unit capacity is equivalent to 3.70 lb. of moisture evaporated, 0.56 lb. of solids consumed, and 4.26 lb. of moisture and volatiles per square foot of net hearth area per hour. For 1950 the average feed rate was 1.7 tons per hour of cake containing 28.8 percent solids of which 38.4 percent were volatiles. This is equivalent to 2.87 lb. moisture evaporated, 0.43 lb. of solids consumed, and 3.32 lb. of moisture and volatiles per sq. ft. of net hearth area per hour.

Operating reports indicate that it is necessary to shut down this unit for 15 percent of the time in order to make repairs such as renewing rabble teeth and replacement of rabble arms.

An air preheater of the sectional plate type was originally installed with 2,484 sq. ft. of heating surface. All of the equipment within the preheater was removed after the incinerator was placed in operation and the unit lined with firebrick so as to serve as a flue. The preheater became so caked up that it limited the passage of hot gases and greatly restricted the incinerator capacity.

As originally installed, all of the rabble teeth on the arms over the upper hearth were directed so as to move the sludge toward the outer edge. Two rabble teeth on each arm have been reversed so as to hold back some of the sludge cake and increase the drying time. Observations have shown an unusually deep accumulation of sludge cake, well broken up and well mixed as a result of this minor change. Ordinarily the top two hearths in this unit are drying hearths. The third and fourth hearths are combustion hearths and the fifth and sixth are for completion of combustion and cooling off of the ash.

Some of the heat from the exhaust gases is reclaimed under low-pressure steam boilers and used for heating the plant buildings and the sludge digestion tanks.

As in a number of other plants employing sluicing, ash handling has given considerable trouble at the Columbus plant. Lime is used for sludge conditioning and has accumulated as $CaCO_3$ in the ash hopper and in the ash lines to an extent requiring considerable work for removal. Clinkers have accumulated in the ash tanks and have been difficult to remove. This experience points to the desirability of having a quick-opening gate between the lower hearth and the ash hopper so that ash can be stored on the lower hearth while the work of removing clinkers and lime encrustations in the ash tank is carried on. Also clinkers find their way into the slurry pump, causing serious cutting of the impeller and rubber lining.

Difficulties with calcification in the wet ash discharge lines have led at Columbus to serious consideration of

discharging the ash in a dry condition. The operators are of the opinion that if wet ash from lime conditioning sludge must be pumped, ample provision should be provided for removal of encrustation and the pipeline should be readily accessible for cleaning operations.

The incinerator chimney at Columbus includes a lined steel stack manufactured by Pratt Daniel and designed for a head induced by a cold air fan which acts as an injector. Cold air is forced into the stack near the restricted section so as to create a draft of up to 2 in. in the gases from the incinerator and boilers. The cold air induced-draft fan has a variable-speed drive and the draft can be governed within desirable limits. This arrangement eliminates a hot air induced-draft fan and provides an excellent means for regulation of incinerator operation.

Ashland, Ohio.

The results of incineration of liquid sludge at Ashland, Ohio in a multiple-hearth unit have been reported by Laboon.* This unit is 9 ft. 3 in. outside diameter. As initially built it had four hearths. It was found advisable to add two hearths in order to incinerate concentrated liquid sludge in this unit.

The results of 6 days of tests made during September and November, 1947 have been given by Laboon. The unit was operated 140.33 hours, evaporated 146,499 lb. of moisture, consumed 18,473 lb. of volatiles, and passed 6,130 lb. of ash during the period. The unit rate of operation was about 5.39 lb. of moisture evaporated and 0.68 lb. of volatiles consumed per square foot net hearth area per hour.

Summary.

On the basis of operating experience some of the features of design, construction, and operation of multiple-hearth furnaces to be used for drying and incinerating sewage sludge requiring particular care follow:

1. There should be ample capacity to discharge the products of drying and combustion. The drop holes should be of such size as to pass the hot gases upward and the sludge downward without clogging and undue loss of head.

2. Preheaters are not necessary for economical incineration of raw sludge cake.

3. Preheaters if provided should be a type which can be cleaned with facility. An ample bypass should be provided for each preheater unit so that it may be cleaned while the incinerator unit remains in operation. Preheaters of the closely spaced plate type are not satisfactory for this type of service.

4. Adequate means should be provided to permit an even rate of feed to the incinerator unit, particularly of moisture and combustibles. The rate of feeding relatively low volatile grit and relatively high volatile scum should be subject to fairly close control.

5. The rabble arms and teeth in the combustion hearths should be of heat resisting alloys. The central shaft at combustion hearths should be suitably insulated. A liberal allowance should be made as to the extent to which combustion may proceed above and below the theoretical average combustion zone.

6. Consideration should be given to the protection of the incinerator stack against high temperature gases under certain conditions and against the corrosive action of acid and moisture under certain other conditions.

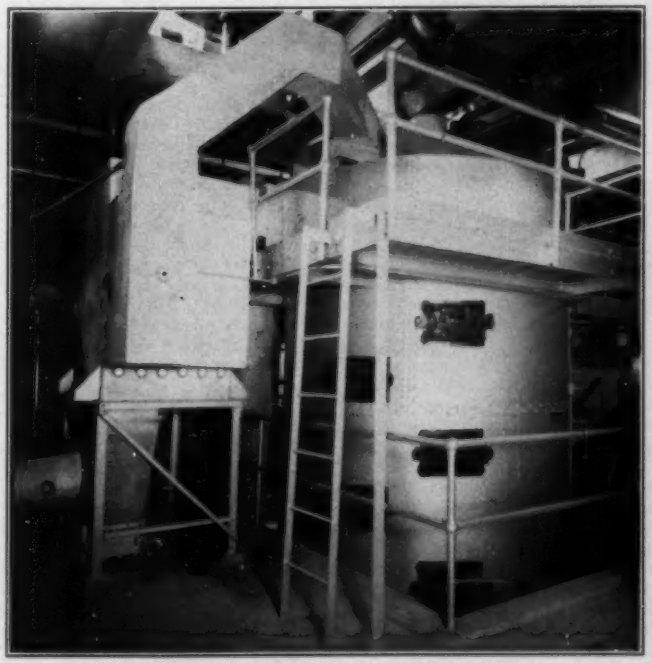
7. The ash system should be designed for ready access. A shutoff gate is desirable between the lower hearth and the ash system so that the latter may be worked on while the incinerator unit remains in operation. Ash slurry discharge lines should be designed so that stoppages may be cleaned or encrustations removed. Duplicate ash discharge lines may be required in order to make it unnecessary to shut down the incinerators while working on the ash line.

8. Adequate ventilation should be provided in sludge drying and incinerator buildings so that working conditions are not too uncomfortable.

Acknowledgement

Acknowledgement is gratefully made for data supplied by Fred H. Burley, Engineer of Sewage Treatment at Detroit; Kerwin L. Mick, Chief Engineer and Superintendent of the Minneapolis-St. Paul plant; George E. Flower, Commissioner of Sewage Disposal at Cleveland; James H. Blodgett, Superintendent of Sewage Treatment Works at Columbus; and Robert W. Rowen, Vice President of Nichols Engineering & Research Corporation.

(The next article, now in preparation, will deal with flash driers, rotary driers, and other types of sludge disposal equipment.)



Auburn, N.Y.—Six Hearth Nichols Incinerator; 29 Tons Per Day

*John F. Laboon, Sewage Works Engineering, 1949, p. 64

A Formula for Designing Settling Tanks

Which Supports That Advocated by Poepel and Advanced by Keefer

by CARROLL H. COBERLY, *Consulting Engineer, Denver, Colo.*

I WAS very much interested in the article on "Settling Tank Design" by C. T. Keefer of Baltimore and Prof. Poepel of Stuttgart, Germany, published in *Water and Sewage Works* magazine of October, 1950. I have also noted the attack on this article by Messrs. H. M. Gifft and J. E. McKee in the February, 1951 issue. My principal interest, of course, was the offering of an actual mathematical formula for the design of settling tanks. I consider Professor Poepel's formula to be absolutely correct and, for the following reasons.

Some Proof

About 1935 I developed a formula by an entirely different method which is identical with Formula 16 in the Keefer-Poepel article. It has been applied with the following results.

Case I—In 1940 I built a sewage plant with two settling tanks based on my formula. They were five feet deep, to meet the requirements of the State Code of a 2-hour detention time, but had the proper area. This plant worked nicely and functioned to effect a suspended solids removal of 70% and BOD removal in a little less—about 68%.

Case II—In 1941 I built a circular settling tank on a water system. It was 1½ feet deep at the overflow weir and two feet deep at the center. It was impossible to get a test of suspended solids at either the influent or effluent end, for the water was so clear. At the end of twenty-four hours, however, there was ⅛ of an inch of sediment deposited, made up mostly of crawdads, worms, and carbonaceous matter. Another tank of the same kind is planned for this community, based on the performance of the first.

Case III—In 1942-43 I built two plants for the Army, with the settling tanks only five feet deep. Both primary and secondary tanks having a record of suspended solids and BOD removal of 95 to 96%.

Case IV—In 1947 I built a tank three feet deep that effected a suspended solids removal of from 50 to 80% depending on the *amount* of flow.

Case V—In 1949 I built a tank four feet deep that has shown a consistent removal of 75%, and better, of suspended solids.

The examples stated above are concrete proof of the correctness of the formulas of Prof. Poepel and that developed and employed independently by the writer during the past 15 years.

Some Pertinent Considerations

Settling is a mechanical process and must be considered from the standpoint of mechanics. There are many variables that influence settling. None of these, however, destroy the mechanics of settling particles. Viscosity of water and sewage changes between summer and winter, or even during different times of the day. Autoflocculation only increases the settling *rate* of the solids. Wandering currents can only be controlled mechanically. Different size of particles that change from hour to hour, convection currents that may buoy up a particle—none of these things change the mechanics.

In designing a settling tank it is only possible to design for *one* condition. This may be taken as the worst condition, or it may be taken as the average condition.

The settling velocity of sewage particles follows Stokes' law and Stokes' law can be used for any *one* particular set of conditions, but it will not cover more than *one* range of conditions. It is rather out of place, then, to go through the effort of working out the settling rate of a particle according to Stokes' law when this solution may be entirely wrong during different times of the year and even during different times of the day. A close theoretical consideration of the problem under these conditions is impossible, excepting possibly in a laboratory test where close observation is necessary.

In considering the settling of particles as a mechanical problem, the first question is answered by Stokes' law—that any particle with a density greater than water has a definite settling rate and given sufficient time will settle to the bottom of the container.

The next question: In a continuous flowing through tank there must be a velocity from the influent end to the effluent end and the length of tank divided by the velocity is the TIME.

Two Forces to Consider and Design For

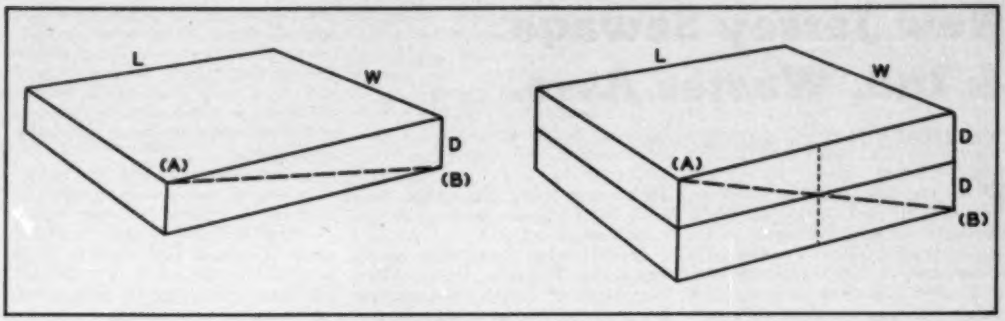
You have two forces then—the settling rate of the particle and the flowing through velocity. Looking at the accompanying sketch, a particle starting at position A with a settling rate of H and a velocity of V will follow the resultant of these two forces and will reach the point B at the end of Time (T). D, then, equals the thickness of current to get the particle out of the flow or HT. If the velocity is cut in half, L divided by V will be twice the original time. A particle will settle 2H and the thickness of flow will be 2D and the particle is out of the current at exactly the same forword position that it was before. From this, it follows that velocity has no influence on the removal of particles from the flow. This is borne out in the formula; one condition supports the other.

Control of velocity in a settling tank is impossible. It is very easy to demonstrate that velocity varies in different parts. If the kinetic energy of the influent is greater than the energy gradient of the tank, this excess energy must be dissipated in some way. It is customary to use baffles to do this. If the baffles are properly set, the excess energy will have little influence on the settling compartment. It is seldom, however, that baffles are able to completely control and dissipate this energy. The result is that wandering currents are set up in the settling portions of the tank and these wandering currents are liable to channelize the flow from one end of the tank to the other, and even at times cause reverse currents.

Wind currents also definitely channelize the flow, especially in a circular tank. A tank with a level overflow weir will have a greater depth of overflow on the side away from the wind and no flow on the windward side. This is a condition that cannot be avoided in large open-air tanks.

The idea of having portholes for the flow to enter the tank at different positions vertically has only the advantage of dissipating the excess energy. It probably does slow the velocity down in the tank, but as shown before, this does not help the settling. *Area* is the only thing to be considered in the design of a settling tank. Theoretical detention time does not mean a thing.

It is quite obvious (and observable) that a tank with an influent baf-



fle and an effluent baffle to hold the grease back creates in a certain portion of the upper part of the tank practically no flow whatever. It is also true that the velocity should not reach down into the zone of compacting sludge. There is, then, only a certain proportion of the tank that can and should be in motion. The thinner this portion, the better the results in the percentage of removals, and the less danger there will be of undesirable bacterial action occurring.

During the winter when the influent is at a higher temperature than the atmosphere, there is bound to be a certain amount of convection currents that definitely hinder settling, if the influent passes under baffles and enters the settling compartment at some point below the surface. During the winter the viscosity is also greater, slowing the settling rate of the particle over what it is in the summer.

Most of the variables have a tendency to reduce the efficiency of a settling tank, and none of these appear in theoretical calculations.

The Formula Employed

The following formula, which was employed in the cases cited, is based on the fundamental conditions:

Q = quantity of flow in cu. ft./sec.
V = velocity through tank in ft./sec.
D = the depth of flow
L = the length of tank
H = the settling rate of particle
W = the width of tank
T = time of flow through tank.

(1) $Q = VDW$

(2) $\frac{L}{V} = T$

(3) $TH = D$ or $T = \frac{D}{H}$

(4) $\frac{L}{V} = \frac{D}{H}$ or $D = \frac{LH}{V}$.

Then, substituting for D in No. 1—

(5) $Q = \frac{VLHW}{V}$

V cancels out and the final formula is—

(6) Q = LHW; LW = area of tank.

In the accompanying sketches, if a particle starts at the top and the beginning of the flow (as at A), it will follow the resultant of two forces—the velocity through the tank in a horizontal position and the settling rate of the particle in a vertical position. The total distance that the particle has settled (B) at the overflow end of the tank is equal to "D" and should be the thickness of the flow passing through the tank. The formula is developed from these considerations.

The settling rate of the particle is the rate as given by Stokes' Law. If this is expressed in feet per second and the quantity of flow is expressed in cubic feet per second, the area of the tank required can be directly found by dividing the settling rate of the particle into the quantity of flow.

The following proposition develops from this logic. The surface of the tank remains constant for any given settling rate of particle.

The shape and thickness of current through the tank are dependent on the kinetic energy entering the tank.

Order	Diameter mm	Settling Rate mm/sec.	Settling Rate ft./sec.
Gravel	10	1000	
Coarse sand	1	100	0.328
Fine sand	0.1	8	0.026
Silt	0.01	0.154	0.000505
Bacteria	0.001	0.00154	0.00000505

Westchester County and New York's Water Supply

Although New York's reservoirs are now running over and the specter of water shortage and rationing seems dim in the past, the Westchester Water Works Conference has just issued a study of the "Influence on Westchester County of the New York Water Supply System."

Lying immediately to the north of New York City and containing many of the commuters to the metropolis, Westchester County now uses approximately 61 mgd. of water of which slightly more than 50 per cent is purchased from the New York City supply. Two out of six cities in the county depend entirely on New York City water; 8 out of 22 villages depend on New York, and 4 out of 16 towns depend entirely on the New York supply. Other cities, villages and towns depend in part on New York's supply.

This is the fourth in a series of reports on the subject; the first, in Nov. 1949, dealt with water supply systems in Westchester Co.; the second, in Mar. 1950 dealt with the answers to a water resources questionnaire; the third, in July 1950, was a study of water consumption in the county. The fifth report in this series will explore a possible unified water system for the county, and the sixth will cover water resources in the county.

These reports are being prepared by the Water Resources Committee of the Westchester Water Works Conference. The committee consists of A. E. Kassay, Supt. of Water and Sewers, North Tarrytown; James R. Losee, Village Engr., and Supt. of Water & Sewers, Tarrytown, and Arthur Richards, Village Engineer, Larchmont. Copies of the report may be obtained from the Committee office in the County Office Building, White Plains, N. Y.

New Jersey Sewage & Ind. Wastes Assn.

36th Meeting Held In Atlantic City

FOR the first time in thirty-six years, the New Jersey Sewage & Industrial Wastes Assn. held an annual meeting outside of Trenton, N.J., when it met at Atlantic City on Mar. 14-16. It had been necessary to change the constitution of the association in order to have the meeting in any city but Trenton. Because of the long standing tradition of meeting in the capital, there had been considerable speculation as to whether or not the attendance would match the previous year, and during the meeting many persons kept the registration desk busy answering the question, "What's the registration, now?"

By the end of the three day session, the total registration reached 306, forty-five short of the previous year, but still a satisfactory number for this experiment. As a result of the good turn-out, plans were made to hold the meeting in Atlantic City again next year. There were nineteen exhibitors at the meeting.

Moderators at the several sessions were: John Struss, President, NJS & IWA, Supt. of Sewage Treatment, Wildwood, N.J.; Paul Molitor, Jr., Second Vice Pres., NJS & IWA, Supt., Sewage Treatment, Tri-Boro Sewage Treatment Plant, Rutherford, N.J.; Sol Seid, First Vice Pres., NJS & IWA, Supervisor, Dept. of Public Works, New Brunswick, N.J.; and P. N. Daniels, San. Engr., City of Trenton.

Business Session

Officers of the NJS & IWA are elected for a two year term and last year's elected officials hold over, except for the Secretary-Treasurer, who is elected yearly. As heretofore, MICHAEL S. KACHORSKY, Supt. Manville, N.J., was unanimously elected to that office.

Also elected at the business session was HARRY P. CROFT, Retired Chief, N.J. Dept. of Health, who becomes a member of the association executive committee. HENRY VAN DER VLIET, Supt., Sewage Treatment, Maywood, N.J., was elected as Director of the Federation. He will take his seat on the Board of Directors at the end of the St. Paul Meeting of the Federation and will replace Louis J. Fontanelli, Supt. of the Rahway Plant.

Sol Seid
Supervisor
Dept. Pub. Wks.
New Brunswick
(1st Vice Pres.)

Paul Molitor, Jr.
Supt.
Tri-Boro Sew. Wks.
Rutherford
(2nd Vice Pres.)

John Struss
Supt.
Sew. Treat. Wks.
Wildwood
(President)

M. S. Kachovsky
Supt.
Sew. Treat. Wks.
Manville
(Secy.-Treas.)

L. J. Fontanelli
Supt.
Joint Mtg. Wks.
Rahway
(Fed. Director)

N. J. Association Brass Hats

Worcester, Mass. Film

"CONSTRUCTION FILM OF WORCESTER, MASS. SEWAGE TREATMENT PLANT," by John L. Hayden, Cons. Engr., Hayden, Harding & Buchanan, Boston, Mass.

Before the actual presentation of the film, Mr. Hayden explained that Worcester is the largest industrial city not on a principal waterway. Pickling wastes from steel and wire industries has constituted the worst industrial waste problem. So heavy was the discharge of iron wastes to the sewer that the trickling filters became clogged with iron oxide from top to bottom of the 10 ft. filters. Ponding was so severe that the filters were practically inoperable.

Cooperative study with the industries showed that a cheap method of disposal of strong pickling liquor could be effected by hauling the strong waste to a spoil land. Rubber lined tank trucks are used. The method has been in use now for three years and is quite successful.

Mr. Hayden then showed the motion picture which vividly depicted the problem of the plugged filters and showed how the plant was redesigned and rebuilt, with several filters being constructed right in the old filters plus an additional number of new filters.

Distinguished Visitor
Earnest Boyce
Head
Civ. Engr. Dept.
Univ. of Mich.
Ann Arbor, Mich.
(Vice Pres.-Fed. S & IWA)

Industrial-Municipal Cooperation

"AN EXAMPLE OF COOPERATION BETWEEN INDUSTRY AND A MUNICIPAL SEWAGE TREATMENT PLANT," by L. W. Stieger, Chem. Engr., Maywood Chemical Works, and Henry Van Der Vliet, Supt., Sewage Treatment, Maywood, N.J.

Mr. Van Der Vliet described the problem of a small community in which the sewage is dominated by the industrial waste load of a couple of chemical industries. It was the old story of growth through the years, of both the community and the industrial waste load. In recent years, the city and the industries have attacked the problem together, with the industries reducing the load by bottling up wastes, and the municipality enlarging its facilities to handle the combined domestic and industrial waste.

Small Sewage Flows

"THE PROBLEM OF HANDLING SMALL SEWAGE FLOWS" by L. J. Nemecsek, Engineer, Ralph B. Carter Co., Hackensack, N.J.

Mr. Nemecsek mentioned six points as desirable factors in handling small sewage flows:

1. Elimination of the bar screen is desirable to avoid the necessity for handling screenings.
2. The equipment for handling the small flows should not be aggravated by the presence of solid matter.
3. Elimination of wet or dry wells has many distinctive advantages in small pumping station operation.
4. The equipment for handling the sewage flow should have a positive discharge under all conditions.
5. Facilities for handling sewage flows should be such that all odor is eliminated.
6. The capacity of the equipment for handling small flows should be highly flexible.

With these points in mind, Mr. Nemecsek proceeded to explain to the audience how the pneumatic ejector embodies all of these desirable features; he particularly referred to the ejector manufactured by the R. B. Carter Co. and displayed in the exhibit hall.

Digester Heating

"External Heating of Digesters" by Paul J. Cerny, Engineer, The Dorr Co., Stamford, Conn.

By the use of slides, Mr. Cerny showed the construction and operation of the Dorr Spiral Heat Exchanger for the external heating of sewage sludge in digestion. Among the points mentioned in his discussion, Mr. Cerny brought out that external heating affords greater control of digestion tank heating; furthermore, such heating is less costly than heating digestion tanks with internal coils, both as to installation and total maintenance. Several companies now offer external heat exchangers.

New Plant Problems

"Breaking in a New Sewage Treatment Plant" by Calvin Ellis, Supt. of Public Works, Moorestown, N.J.

Mr. Ellis reviewed the problem that had existed for many years whereby a heavy pollution load on a small creek had resulted in sludge banks, with their attendant odors and other noisome conditions. To eliminate this problem a sewage treatment plant was constructed to afford combined sedimentation and digestion, trickling filters, and chlorination. The digestion is unheated and the sludge is to be filtered on a Komline-Sanderson Coiled Spring Vacuum Filter and burned with the local refuse.

Mr. Ellis vividly told of the problems encountered in starting this plant. It seemed as though everything went wrong; the chief operator became ill and was not available for a long period of time during the break-in operations; storm water was more than had been anticipated and connections to roof drains had to be removed from the sewers; sewers had to be dug up; sticks from the sewers interfered with the operation of the comminutors; the digesters foamed; the sludge beds were overloaded.—Truly, the lot of the man who starts a new sewage plant is not a happy one.

Dow Chemical Co. Film

One of the most outstanding motion picture presentations of the problem of industrial waste treatment was shown in the film, "Air, Water, and Industry" prepared by the Dow Chemical Co. of Midland, Mich. To those persons familiar with the work of this company in its attack on the problem of industrial wastes, the film was a dramatic record of the success of Tom Powers, Waste Disposal Engineer of that company. The film is more than just a pictorial record of how the problems at Midland are solved; it is an excellent piece of public relations material that would be of interest to persons interested in municipal sewage problems as well as those of industry. (This reporter recommends that other sewage and industrial wastes associations obtain this film for showing at their meetings.)

Comminutors

"Worthington Comminutors—Illustrated" by J. P. Messina and R. Griswold, Engineers, Worthington Pump and Machinery Corp., Harrison, N. J.

Mr. Messina showed slides of the Worthington Comminutor and pointed out that this type of equipment replaces hand raked screens in sewage plant; it also eliminated the need for mechanically raked screens and the problem of disposal of those screenings. Comminutors require that grit be removed before the sewage passes through the unit.

Features of the Worthington unit include: easy installation in a straight channel; (i.e. no special forming of the channel) and ease of removal of the blades. The illustrations showed the design, construction, and operation of the unit.

John L. Hayden
Cons. Engr.
Boston
Mass.

L. J. Nemecsek
Engineer
R. B. Carter Co.
Hackensack, N.J.

Programmers

Paul J. Cerny
Engineer
Dorr Co.
Stamford, Conn.

J. P. Messina
Engineer
Worthington
Harrison, N.J.

Calvin Ellis
Supt.
Pub. Wks. Dept.
Moorestown, N.J.

New Fed. Director
Henry Van Der Vliet
Supt.
Sew. Treat. Wks.
Maywood, N.J.
(Elected to 3 yr. term beginning Oct. 1951)

Operator Training

"Twenty-Two Years of Training Sewage Plant Operators" by B. I. Corson, Instructor, Camden County Vocational School.

Mr. Corson started his course in sewage plant operation training because of the interest shown during his early course on water plant operation. For 22 years he has conducted night classes on the subject in the only school of its kind that is open to the public. The course originally consisted of simple laboratory exercises and class room work, but now it consists of one 3-hour class-lab. in chemistry and biology, and one 2-hour class in hydraulics, weekly over a period of two years. One hundred twenty hours are required for graduation in the two

year period. To date, 150 persons have enrolled, 20 have graduated, and 20 more have obtained state licenses for sewage plant operation without having graduated from the course.

Mr. Corson told of the change in type of student over the years and explained the problem of teaching both theory and practice together. He emphasized the fact that there is no good text-book for that purpose. He hopes one will be written because he expects part time classes to be around for a long time.

Industrial Wastes—A Philosophy

"INDUSTRIAL WASTES—A WORMS-EYE VIEW" by L. L. Hedgepeth, Technical Consultant, Calco Chemical Div., American Cyanamid Corp., Bound Brook, N.J.

Although Mr. Hedgepeth opened his talk with a recounting of some of the approaches of his company to the problems and some of the results, he devoted the principal part of his talk to expressing his own opinions as to a philosophy of industrial waste pollution abatement.

Much of Calco's work to date has been to study new methods of waste treatment as well as new adaptations of old methods and to study possibilities of waste elimination. They have, for example, learned to strip color from wastes with chlorine, to remove B.O.D. by chemical precipitation, to treat some wastes on trickling filters, to obtain 90 per cent removal of B.O.D. of some wastes by lagooning at a neutral pH, to discharge some wastes to deep underground brine pools, and other techniques. These approaches all look promising.

Speaking for himself, Mr. Hedgepeth remarked that after many years of looking up the tail pipes of industry, he still could see no glamour in industrial waste treatment per se. Industrial waste has a massive and debilitating influence on streams in this country. The reason: poor location of plants on streams with respect to the ability of the stream to accept the waste load.

It is well understood that liquid wastes can only be eliminated by the substitution of anhydrous manufacturing processes or by shutting down the plants. Neither of these can be done entirely and therefore it must be recognized that the plants must have water, but it should be recognized also, that the stream must be protected from over-loading.

According to Mr. Hedgepeth, the responsibility rests not only on the industry, and the public which wants a payroll, but also on our profession as sanitary engineers. He deplored the fact that our profession has been given to pious platitudes on the one hand while condoning gross pollution on the other. We are torn between economics and the stream; but as Prof. Velz has pointed out, the stream is a stern banker and won't allow a default on the payment of oxygen.

Mr. Hedgepeth feels that too often a study, either the first or a repetition, reveals only what we already know, that dilution is the only answer. As a result we have recognized the reality where dilution is not sufficient, and, knowing that we cannot shut down the plant, we have let the stream remain polluted; or we have passed a law saying the stream cannot be polluted but have not enforced the law because in reality the pollution cannot be abated.

The trouble, says Mr. Hedgepeth, is with sanitary engineers. Industrial management and municipal management don't know the answer, but sanitary engineers do know the answer. We should recognize that conservation transcends economics and we have an obligation to recognize that fact. Unless we do, we shall always end up with a compromise between wise use and abuse—and we shall always be behind in our fight for pollution abatement.

The problem can't be resolved with mere pencil and paper, we have a selling job to do. The government can't do it, even under Public Law 845. We as a profession are slipping backwards in our attempts to solve the pollution problem especially now in this time of rearming. Mr. Hedgepeth called for rearming and conservation to go hand in hand. Publicity and public relations are commendable and desirable but "you can't talk industrial wastes out of streams."

The realistic approach is to plan for plant relocations where possible, to locate new plants where water is available if necessary, to control manufacturing to eliminate as much waste as possible, and to treat the effluents of plants before they enter a stream. It should be our policy as engineers in this field to keep present streams clean where they are clean, to reduce present pollution, and to avoid future pollution by sensible planning. If we do, we can solve the problems that confront the nation in regard to water pollution; if we don't follow this policy, we shall continue to lag in our efforts.

J. H. LeChard
Ch. Engr.-Mgr.
At. City Sew. Co.
Atlantic City, N.J.
(Arrangements)

L. F. Frazza
Dist. Mgr.
"Transite" Pipe
Hawthorne, N.J.
(Arrangements)

Committeemen

L. E. West
Ch. Engr.
Jt. Mtg. Sew. Wks.
Elizabeth, N.J.
(Executive)

F. Van Orden
Supt.
Sew. Treat.
Benardsville, N.J.
(Executive)

P. N. Daniels
Saw. Engr.
Trenton,
N.J.
(Executive)

J. J. Horgan
Sales Mgr.
R. B. Carter Co.
Hackensack, N.J.
(Program)

Camden's Program

"CAMDEN'S INTERCEPTING SEWER AND SEWAGE TREATMENT PROGRAM" by C. A. Emerson, Consulting Engineer, Havens and Emerson, New York, N.Y.

In the absence of Mr. Emerson, the paper was read by Walter A. Leach of Mr. Emerson's office. The paper reviewed the problem at Camden and described the basis for design including such problems as infiltration, storm water, industrial wastes and other factors.

The interceptors are designed to carry 110 per cent of the maximum flow estimated for the year 2000 A.D. (90.6 mgd.) There are to be two treatment plants, the main plant having a design flow capacity of 53 mgd., while the small plant has a flow of 3.9 mgd. The small plant will have an activated sludge treatment process, the main plant will be of the trickling filter type.

B. I. Corson
Instructor
Com. Co. Voc. Schl.
Oaklyn, N.J.

L. L. Hegdepeth
Tech. Cons.
Amer. Cyanamid
Bound Brook, N.J.

W. A. Leach
Partner
Havens & Emerson
New York, N.Y.

John Boardman
Engineer
Tucodel
Philadelphia, Pa.

Programmers

D. J. Cestoni
Waste Disp. Engr.
Merck & Co.
Rahway, N.J.

Robt. Shaw
Act. Ch. Engr.
St. Dept. Hlth.
Trenton, N.J.

Federation Report

EARNEST BOYCE, Head, Dept. of Civ. Engr., and Prof. of San. Engr., University of Michigan, Ann Arbor, spoke as the representative of the Federation in his capacity of Vice President of the Fed. Sew. & Ind. Wastes Assns. Prof. Boyce reviewed the early organization meeting of the Federation held in Trenton 23 years ago. He also spoke on some of the work now being done by the Federation and its committees and of plans for the future.

Operators and Clean Streams

"NEW JERSEY SEWAGE TREATMENT PLANT OPERATORS IN THE STATE PUBLIC HEALTH PROGRAM" by Robt. Shaw, Acting Chief Engr., Bur. Pub. Health Engng., State Dept. of Health, Trenton, N.J.

Mr. Shaw called attention to the importance of the plant operator to the clean stream program of the State. He explained the reasons for the change in availability of help to the operators during the war. He also told how the reorganization of the department and the setting up of five districts would once again bring the Health Department engineers into closer contact with the sewage plant operators of the State.

Air Pollution

"AIR POLLUTION ABATEMENT TODAY" by Dominic J. Cestoni, Waste Disposal Engineer, Merck and Co.; Rahway, N.J.

Pointing out that sometimes air pollution abatement leads to water pollution, Mr. Cestoni went on to discuss the ramifications of the subject of air pollution. That there must be cooperation between the public and industry is evident, but the approach to air pollution abatement is still so infant that as yet there are no yardsticks as to what constitutes pollution. Obviously the air cannot be overloaded just as is the case with streams, but the real problem is the effect of the discharge on the immediate area.

How to evaluate the nuisance factor is the first stumbling block in air pollution abatement. It is not necessarily, what is the contamination, but how it may interact with other air-borne pollution and what effect it has on people. Actually the problem of air pollution abatement is to minimize discharges to a level acceptable to unpredictable human beings.

To illustrate some of his points, Mr. Cestoni cited the Los Angeles smog problem and the famous Donora, Pa., incident. In the latter case, a thorough study of the problem (created by inversion of the air) made no positive recommendations; all that could be said was that the chemical discharges to the atmosphere should be minimized; no level was given. The air pollution abatement problem is definitely in its infancy but no doubt sanitary engineers will find it more and more in their province in the future.

Raritan Valley Trunk Sewer

"THE RARITAN VALLEY TRUNK SEWER SYSTEM" by George F. Smith, Chairman, Middlesex County Sewerage Authority, and President, Johnson and Johnson, New Brunswick, N.J.

Although Mr. Smith had spoken on the same subject two years ago in Trenton, he now had definite progress to report. He did so by first reviewing the history of the Raritan River and its pollution since 1915. Now, there has been formed a Sewerage Authority, preliminary studies have been completed, engineers' plans are being prepared, and the next steps in the program are blueprinted.

All recent studies have pointed to the solution of the problem by a trunk sewer to accept all of the domestic and industrial waste along the Raritan River. The proper location of the outlet has been ascertained. Methods for treatment of the combined waste at the end of the trunk sewer have been investigated. There is no doubt in the minds of the Authority as to the overall plan for handling the problem. The engineers plans will be presented to the Authority in April; the next step

W. H. Stewart
Pres.
W. H. Stewart Co.
Syracuse, N.Y.

R. B. Carter, III
Engineer
R. B. Carter Co.
Hackensack, N.J.

Manufacturers' Representatives

*J. M. Davidson**
Dist. Sales Mgr.
Penn. Salt Mfg. Co.
Philadelphia, Pa.

A. T. Leahey
San. Engr.
St. Hlth. Dept.
Trenton, N.J.

Licensing Law

Geo. F. Smith
President
Johnson & Johnson
New Brunswick, N.J.
(Chair., Sew. Auth.)

W. Rudolfs
Chief
N.J. Agr. Exp. Sta.
New Brunswick, N.J.
(Consultant)

Raritan Valley

*Introducing John Davidson, successor to "Ted" Wilson, who is now working on procurement problems.

will be to contact the several industries in the Valley (they will contribute 65 per cent of the total waste) and the communities and to sign contracts for the use of the system. Thereafter the Authority will proceed to float sewer revenue bonds, advertise for bids on the contracts, and start construction. Mr. Smith hopes that the system will be complete and in operation in late 1953.

Discussion of the subject was afforded by E. MERRILL SEABERG, Chairman of the Bergen County Sewer Authority and Mayor of Tenafly, N.J. Mr. Seaburg recounted some of the problems of building a trunk sewer in Bergen County and of obtaining the necessary contracts with the contributing cities. In spite of the problems involved, the plan has gone through and the system will be operating within the year.

The first phase of the program was for 11 cities, the second stage will take in 29 more municipalities. While the cost of floating the bond issue was higher than expected (because of the newness of the type of bonds in N.J.), refunding is expected to lower the financing costs appreciably. Where contributory communities have their own sewage plant at present, they will be reimbursed to the extent of the remaining indebtedness on such plants. Because of increased costs, the service charge will be $132 per mil. gal. instead of the anticipated charge of about $100.

Operators' Symposium

Under the leadership of P. N. DANIELS, Sanitary Engineer, City of Trenton, N.J., an operators' breakfast and symposium was held on the last morning of the session. More than 150 persons attended.

ANTHONY LEAHEY, Public Health Engineer, State Dept. of Health, spoke on the New Jersey Sewage Operators Licensing Law. Following his talk he conducted a question and answer period on the subject.

M. S. KACHORSKY, Borough Engineer, Manville, N.J. presented the latest information on the procurement of supplies under D.O. orders. He also passed out copies of the brochure which answers many of the questions asked in respect to the subject of materials procurement under the National Production Act.

The Delaware River Basin Project

A highly interesting and very attractive brochure has been issued by the Interstate Commission on the Delaware River Basin, commonly known as INCODEL. This brochure is published in the interest of setting forth the story of the proposed "integrated interstate water project" which will make the waters of the Delaware River have the greatest service to the greatest number of persons of any water system in the world.

This is the proposed water supply system and control of flood and salt waters which was featured in papers presented at the Philadelphia meeting of AWWA last May. Prepared strictly as a public relations and promotion piece this brochure, nevertheless, presents the problem and its proposed solution in a very readable manner.

For copies of this brochure, write to James H. Allen, Executive Secretary and Chief Engr., INCODEL, 581 Broad St. Station Bldg., Philadelphia, Pa.

Alabama Water & Sewage School Scheduled for June

The Alabama Water & Sewage Assn. will hold its annual meeting and short school in June, at the University of Alabama, Tuscaloosa, Ala. The short school will be held from June 11 to 14 with examinations for Classes II, III, and IV water works operators certification (voluntary) on the afternoon of June 14th. Courses will also be given for sewage plant operators, but as yet no provision has been made for a certification plan for sewage works operators.

The annual meeting and banquet of the association will be held on June 15th. Papers on fluoridation and national defense will be presented.

U.S.P.H.S. Announces Exams. for Sanitary Engrs.

Competitive examinations for the appointment of officers as Sanitary Engineers in the Regular Commissioned Corps of the U. S. Public Health Service will be held in various cities throughout the country on August 6, 7, and 8, 1951. The examination will include professional written tests, an oral interview, and a physical examination. Completed applications must be in the Washington office of the Service by July 9, 1951.

Appointments are permanent and provide opportunities for career service in research and public health activities. Appointments will be made in the grades of Assistant and Senior Assistant, equivalent to Navy ranks of Lieutenant (j.g.) and Lieutenant, respectively. Entrance pay for an officer with dependents is $4486 in the Assistant grade and $5346 in the Senior Assistant grade, including rental and subsistence allowance. Applicants must have a bachelor's degree in engineering, preferably in civil, sanitary, or chemical engineering, and by May 1952 must have completed a total of at least three additional years of professional training and/or experience. At least two years of the required experience must have been in public health or an acceptable related field.

For application forms and additional information write to: Surgeon General, U. S. Public Health Service, Federal Security Agency, Washington 25, D.C., Attention: Div. of Comm. Officers, Desk (A).

12th Illinois Sewage Short Course

The Sanitary Water Board of the State of Illinois sponsored the twelfth Short Course for Sewage Works Operators, held on April 2 to 6 at the University of Illinois in Urbana. Known as the "College of Sewage Works Knowledge", this short course has previously drawn 224 students. Heading up the instructional staff were Prof. H. E. Babbitt, Prof. of San. Engr., and J. C. Dietz, Asst. Prof. of Civ. Engr. of the University of Illinois.

Instruction consisted of three lectures each morning with a one hour discussion period each afternoon followed by basic instruction in laboratory methods.

So. Carolina Water and Sewage Short Course

The annual short course of the So. Carolina Water and Sewage Works Assn. was held at Clemson College on Mar. 22, 23, and 24.

There were four divisions of the short school, as follows: Sewage Division—Classes A and B; Sewage Division—Classes C and D; Well Supply Division; and Surface Water Division.

Topics included a wide variety of interests from "Elements of Electricity" and "Outline of Bacteriology and Chemistry" to "Construction, Operation and Testing of Cold Water Meters" and "The Mechanics of Filter Operation."

Purdue Industrial Waste Conference

Second Installment

THE first installment of the report on the 6th Purdue Industrial Waste Conference appeared in the April issue of *Water & Sewage Works*. This second installment reviews a number of the technical papers presented at that meeting. Inasmuch as it was impossible to cover all of the 54 papers presented, the material chosen for reporting was selected on the basis of being representative of the varied interests in industrial waste and its treatment.

As recounted in the previous issue, the nearly 400 persons attending came from 27 states and Canada. As in the case of the previous five meetings, the interest in this meeting again attested to the importance and success of the conferences.

Legal Problems

"SOME LEGAL ASPECTS OF INDUSTRIAL WASTE PROBLEMS," by John H. Murdoch, Jr., Vice Pres. and Counsel, American Water Works Service Co., Inc., Philadelphia, Pa.

Mr. Murdoch showed how certain fundamental legal principles are involved in attempts to solve the complicated problems of waste disposal and regulation. By means of two hypothetical cases, involving these principles, Mr. Murdoch explained to his listeners not only the principles involved but possible common law remedies. He also discussed police power legislation and how it can be used in conjunction with the common law, and he concluded with a general scheme for water pollution control police power legislation.

The purpose of such legislation is to protect and advance the health, safety, and general welfare by protecting the waters of the state. Everyone must understand that no industry or community has a property right, or any right, against the expressed wish of the state, to pollute the waters of the state. While such pollution may have been overlooked in the past or even condoned, it was never approved and such pollution must be abated for the benefit of health and welfare of the people as well as the industries themselves. Where pressure is necessary it is best exerted through sound legislation.

Insecticide Effects on Water

"BLITZ ON INSECTS CREATES WATER PROBLEMS," by L. F. Warrick, Chief, Technical Service Branch, Div. of Water Pollution Control, U.S. Public Health Service, Washington, D.C.

Mr. Warrick presented a number of slides and a motion picture showing cotton dusting operations in the northern part of Alabama during the summer of 1950 and the water problems created by this "chemical warfare" against the boll weevil.

Hosts

Don E. Bloodgood
Prof. San. Engr.
Purdue Univ.
Lafayette, Ind.

F. L. Hovde
President
Purdue Univ.
Lafayette, Ind.

(Photos taken at luncheon by Wm. Haslett, Assn. of Amer. Railroads)

Sparked by the local county agricultural bureaus, 80 to 95 per cent of the cotton growers participated over an area of 419,500 acres in eight counties. The amount of insecticides used varied, but averaged 63 lb. per acre, or more than 26,000,000 lb. A wide variety of formulas were used, but the most prevalent were benzene hexachloride and toxaphene. Aldrin was also used in limited amounts. Climatological conditions favoring survival of the boll weevil dictated the "blitz" attempts.

Rains, both intermittent and successive, washed much of the chemicals into the streams with disastrous effects on the fish and aquatic life; sediment in blitzed areas was toxic to fish months later.

In public water supplies normal water treatment processes (coagulation and sedimentation) are believed to have helped remove insecticides that are relatively insoluble.

In spite of this extremely high dosage of chemicals, the boll weevil damage reduced the cotton crop to about 50 per cent of normal. Growers felt, however, that there would have been no crop at all without the insecticide treatment.

Mr. Warrick pointed out that stream pollution resulting from the use of organic insecticides in agriculture may become a serious problem, and he concluded that recommendations in respect to chemicals now used for control of cotton insects should be re-evaluated in an attempt to prevent similar occurrences.

Small Packing Plant

"DESIGN AND OPERATION OF A WASTE TREATMENT PLANT OF A SMALL PACKING PLANT" by Allen H. Wymore, San. Engr., Burns and McDonald, Kansas City, Mo.

For a small plant with 50 employees killing an equivalent of approximately 36 cattle or 120 hogs a day, waste treatment presents a problem even though paunch manure is hauled away and general cleanliness and good housekeeping are observed.

For a small space, Mr. Wymore designed a plant to handle 83 gpm. for 8 hours with a primary detention of 1½ hours. The accompanying sketch shows how it was done. Both the clarifier and filter are two stage in one unit, one half of the clarifier is a primary settling tank discharging to a primary filter (inner circle) and the other half of the clarifier is a secondary clarifier discharging partly to a secondary filter (annular ring) and partly to the plant effluent. Recirculation is practiced as shown in the diagram.[1] The clarifier is a Dorr Clarigester in which digestion takes plant below the settling zone.

Under present operating conditions the flow averages about 27 gpm. or 32 per cent of capacity. Raw suspended solids averaging approx. 500 ppm. are reduced to about half that amount. Raw B.O.D. averaging about 700 ppm. is reduced to about 135 ppm. although varying rather widely from 60 to 300 ppm. in seven tests. Operation of the plant is considered successful. The plant cost $50,000.

Chlorinating Phenols

"CHLORINATION OF PHENOL BEARING RUBBER WASTES" by N. S. Chamberlin, Chem., Tech. Serv. Div., Wallace and Tiernan, Newark, N.J. and Warren Sechrist, Chief Chemist, Pequannoc Rubber Co., Butler, N.J.

Mr. Sechrist presented the paper and reviewed the processes for rubber reclaiming and the sources and types of waste, acid, chloride and caustic.

Chemical composition and strength of the wastes vary as shown in the accompanying table.

During the studies, several different types of treatment were tried including pretreatment with settling

alone, coagulation with alum, ferric chloride, and copperas, followed by chlorination. Results varied. From the results of the pilot plant study it was concluded that the best treatment is "pretreatment with copperas and settling, followed by chlorination with a subsequent settling or retention time of three to five hours." This treatment "insures a clarified phenol-free effluent with the lowest possible color and odor characteristics. The pH of the chlorinated waste should be adjusted with lime and controlled automatically."

Based on the satisfaction of a chlorine demand of 2,000 ppm. and the pretreatment process it is estimated that the wastes can be satisfactorily treated for $1.66 per 1,000 gal. A treatment plant is now being constructed. I. Russell Riker of Princeton, N.J. is the Consulting Engr.

O-R-P in Biological Treatment

"Application of Oxidation-Reduction Potential to Biological Waste Treatment Process Control," by W. W. Eckenfelder, Jr., Pres., Eckenfelder Associates, Inc., Ridgewood, N.J. and John W. Hood, Supt., Sew. Treat., Ridgewood, N.J.

Mr. Eckenfelder, a serious investigator of oxidation-reduction potentials in sewage treatment, has enlarged his studies to include a number of industrial wastes. In presenting his findings he first reviewed the subject of O-R-P.

Oxidation Reduction Potential (O-R-P) represents the electrical pressure existing in a liquid as a result of the respective concentration of oxidants and reductants present in the substrate. It is essentially an intensity factor analogous to temperature. The conditions affecting the potential of a biological medium and the rate of change of potential are: (1) Kind of organism present, (2) condition of the organism, (3) growth phase of the mass, (4) nature and amount of constituents in the system, and (5) conditions of operation.

A "static" or non-reacting system shows little change in potential with respect to time, and equilibrium is quickly reached. A dynamic system shows appreciable biological activity and proportions of oxidant and reductant are quickly changing. "Poising," which is important in a static system, may be compared to the buffer action effect in pH measurement.

pH will itself have an effect on O-R-P and this effect varies for different systems, and in waste systems a general effect cannot be calculated. In spite of the difficulty of relating O-R-P to pH, O-R-P provides a useful tool in waste treatment and the pH effect can be corrected for by an empirical equation.

Programmers

John H. Murdoch, Jr. Vice Pres. Am. Wat. Wks. Serv. Co. Philadelphia, Pa.

L. F. Warrick Chief, Tech. Serv. Br. Div. Wat. Poll. Cont. U.S. P.H.S. Washington, D.C.

With this basic introduction to the subject, Mr. Eckenfelder discussed O-R-P measurement, equipment and the conduction of an O-R-P Survey in a waste plant. He also cited results obtained in aeration processes, activated sludge, anaerobic digestion, trickling filters, nitrate treatment and textile, dairy, canning and laundry wastes. In discussing each of these subjects the meanings of the results were explained.

Cyanide Treatment with Ozone

"The Treatment of Cyanide Wastes with Ozone," by R. G. Tyler, Prof., Sanitary Engng., University of Washington, Seattle, Wash.

Prof. Tyler presented the results of some experimental laboratory studies. These studies were instigated because chlorine is in short supply and because residual chlorine in treated waste effluents is toxic to fish in some instances. A substitute for cyanide waste treatment was therefore sought. Although there was no background information available, ozone was tried.

The results of these tests indicated that ozone would oxidize CN^- in reasonable time and in what appeared to be reasonable amounts. Control of pH appears to be important. Bubbling of ozone through a 3 ft. liquid column was the method employed. In one controlled experiment 46 ppm. of CN^- was reduced to 2.8 ppm. in 8 min. with no loss of O_3 to the exhaust. In 7 more minutes the CN^- content was reduced to 0.925 ppm. but there was some loss of O_3 to the atmosphere—at the end of 8 min. the mol. ratio of O_3 to CN^- was 1.83 to 1.0; an overlapping of the oxidation of Cynate occurs toward the end of the reaction period. Further studies are planned.

Distilling Industry

"Waste Disposal in the Distilling Industry," by Frank M. Shipman, Vice Pres.-Tech. Director, Brown-Forman Distillers Corp., Louisville, Ky.

Mr. Shipman took the opportunity to explain how industrial management looks at waste treatment. According to Mr. Shipman, industry being "the cash that runs our country, while agriculture and resources are the capital, therefore management must come up with a good annual report." And, that means that waste treatment must receive scrutiny as to how it affects the balance sheet. Education, legal interpretation, cooperation, costs, and all other phases of industrial waste treatment were presented. The subject was discussed from the floor by E. J. Cleary, Exec. Dir. of the Ohio River Compact Commission and by Wm. Hasfurther, San. Engr., Ill. State Dept. of Health.

"Seagram Distillery Waste," by Nelson Roberts, Development Engineer, Joseph E. Seagram & Sons, Inc., Lawrenceburg, Ind.

Mr. Roberts reported on a high rate trickling filter pilot plant operating on the residual distillery wastes after the spent beer and thin stillage wastes are recovered for animal food.

Operating at a 30 mgad. rate the B.O.D. load was applied at 2 lb. per cu. yd.—Seed was developed from river water. During operation, NH_4OH and $(NH_4)_3\ PO_4$ were added to supply nitrogen and phosporous requirements of the biologic slimes.

While the process worked successfully, no operating conditions or rates were discovered which would effect sufficient removal for a large distillery unless a large filter acreage were constructed.

Lake Pollution

"Lake Pollution from Entering Streams," by C. C. DeWitt, Head, Engr. Expt. Sta., Mich. State College, East Lansing, Mich.

Analysis of Reclaimed Rubber Wastes

Constituent	Acid Waste	Chloride Waste	Caustic Waste
pH	2.0–2.8	4.8–6.8	9.8–11.8
Color	60–180	1,500–6,200	375–12,500
Turb.	1,500–2,200	4,000–15,000	2,250–9,250
Susp. Sol. (ppm.)	1,300–3,700	2,100–9,800	1,770–15,300
Phenol (ppm.)	0.0	6.5–20.0	2.5–30
Th. Odor No.	150–600	1,800–9,000	4,000–20,000
Chlor. Dem. (ppm.)	30–60	800–1,750	1,900–7,000

Programmers

S. A. Greeley
Cons. Engr.
Greeley & Hansen
Chicago, Ill.

R. C. Tyler
Prof. San. Engr.
Univ. of Wash.
Seattle, Wash.

W. W. Eckenfelder
Cons. Chem.
Eckenfelder Assoc.
Ridgewood, N.J.

E. J. Cleary
Exec. Dir.
Ohio River San. Comm.
Cincinnati, O.

Presiders

T. F. Wisniewski
Director
Wat. Poll. Cont.
Madison, Wis.

W. W. Towne
Basin Engr.
U.S.P.H.S.
Cincinnati, O.

Mr. DeWitt reported on studies of a small lake 90 ft. deep and the effect on the lake of pollution entering by way of a stream discharging into it. Such data and observations as were available indicated that the polluted zone extended no more than 100 ft. into the lake and covered no more than 6,000 sq. ft. The dilution factor could not account for the disappearance of the B.O.D. load, and no other reason could be found for its disappearance. No information was available on effects of density currents, the thermocline, and other factors.

Phenol Waste Treatment Studies

Termed an outstanding example of a cooperative undertaking, directed at the most effective and economical method of treating phenolic wastes from coke production, Edward J. Cleary reported as Director and J. E. Kinney as Sanitary Engineer of the Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio.

Cooperating in laboratory and pilot plant scale studies were American Rolling Mills Co., Wallace & Tiernan Co., Ozone Processes Co., Mathieson Chemical Co., Dow Chemical Co., the Ohio Valley Commission, the Ohio State Dept. of Health, and the U.S. Public Health Service. Studies were conducted under the general supervision of Mr. Kinney at the Hamilton, Ohio, plant of the American Rolling Mill Co., which participant provided laboratory facilities, especially set up and manned for the project, and later constructed and operated the pilot plant for testing the most promising of the methods developed in the laboratory.

The investigations early revealed that some form of phenol destruction by chemical oxidation was the proper attack. Methods and materials studied involved oxidation with liquid chlorine, hypochlorites, chlorine dioxide, permanganates and ozone.

Mr. Kinney took over at this point to report the technical findings to date. Dephenolized ammonia still wastes in coke production, synthetic phenol production wastes, oil refinery wastes and phenolic resin production wastes all responded to the same types of treatment, proving that chemical oxidation has widespread application in eliminating phenols and phenolic compounds from wastes.

In general, the finding have been the following:

Chlorine alone will destroy the phenolic bodies, but only when the chlorine break-point has been exceeded. The chlorine demand of the wastes, and in particular the high ammonia content of the coke plant ammonia still wastes, render direct chlorination excessively expensive in that 2000 ppm. of chlorine must be added before a beginning of attack on phenols is realized. As much as 5000 ppm. of chlorine is required to complete the destruction of chloro-phenols formed within the zone of dosages from 2000 to 5000 parts per million.

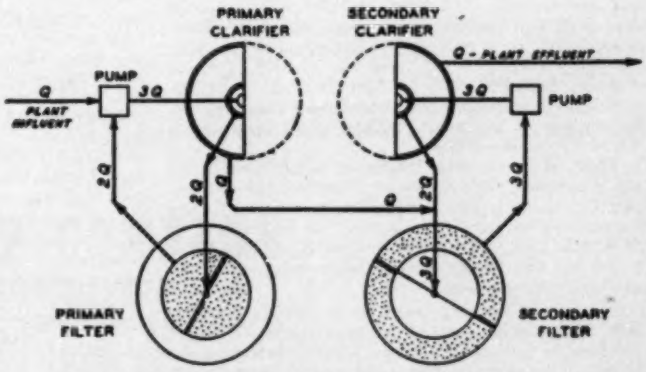
Chlorine dioxide, not being affected by the high ammonia content and chlorine demand of the liquor, was found effective in dosages involving 2000 ppm. of sodium chlorite, which forms none of the objectionable taste-producing chloro-phenols. When used in combination with chlorine (ratio 2 chlorine to 1 chlorite) the effective chlorite dosage is reduced from 2000 ppm to 1000 ppm.—and no chlorophenols are produced. A disadvantage is the 18 hr. contact period required in the chlorite and chlorite-chlorine treatment. Interestingly, acidification of the alkaline waste rendered oxidation with chlorine or chlorine dioxide no more economical or effective. Both performed better on the un-pretreated waste, with high pH value of 11 and above.

Ozone, to date, has offered the greatest promise as the most effective and practical oxidant for the high ammonia containing and chlorine demanding still liquor. Like chlorine and chlorite, it performs best at the high pH of 11.8. The reactions are instantaneous with 600 ppm. of ozone as sufficient.

Questions raised by the audience concerning comparative costs of treatment with ozone and the chlorine-chlorite combinations could not be answered, Mr. Cleary explaining that studies of costs were now being conducted.

Both Cleary and Kinney were loud in their praise of the cooperating agencies (and firms) in this first undertaking of its nature at any point. Especial acknowledgment went to "Armco" management and personnel for their part in the undertaking.

(Continued in next issue)



Flow Diagram—Waste Treatment Plant, Reitz Meat Products Co., Raytown, Mo.

THE EDITOR'S COMMENTS

Pollution Abatement Becoming "Big Business"

Those who attended the 6th Industrial Waste Conference at Purdue University and the recent 5th Annual Conference on Pollution Abatement, held by the Manufacturing Chemists Association in New York City, had a clear insight into the fact that stream pollution abatement is very much on the march in America.

That pollution abatement is rapidly coming into the category of "big business" cannot be debated. Not alone, when learning of the widespread activity in this new component of manufacturing and processing, is this apparent; but, more readily understood by many is the revelation of the size of expenditures by industry in providing facilities and revisions of processes, and/or waste treatment, incident to pollution abatement.

Those attending the enlightening 5th Conference of M.C.A.'s Pollution Committee were given some impressive figures revealing the extent of expenditures by a few of the larger chemical manufacturing concerns which, from this writer's perspective, puts Pollution Abatement (capitalization deserved) in the category of "big business." In his opening statement, as chairman of M.C.A.'s. Pollution Abatement Committee, Lyman Cox revealed that his company (Du Pont) has with certainty already spent $22,000,000 in pollution abatement activities, and at present is spending roughly $3,500,000 each year to further this end. Some other known expenditures included Atlantic Refining Co. as currently spending $3,000,000 at its Philadelphia plant; Dow Chemical Co. at Midland, Mich., at least $1,500,000; American Viscose Corp. at Front Royal, Va., $1,500,000; the coal industry in the Schuylkill River Valley more than $10,000,000 collectively; industry in the Philadelphia area $25,000,000 during the last few years. And, later in the meeting Dr. Roy McCracken, of Du Pont's Rayon Plant at Waynesboro, Va., revealed that his plant had so far spent almost $500,000 re-arranging the process and making changes in chemicals used in production, to the end that sizeable pollution abatement was being realized without the need for construction of a waste treatment plant, for the present at least.

At the meeting of the Canadian Institute on Sewage and Sanitation C. T. Carson, engineer and vice-president of Hiram Walker & Sons Ltd., in a most illuminating paper, to be published in this magazine, revealed the happy results realized at a cost of $1,500,000 for recovery facilities at their Walkerville, Ont., plant, undertaken strictly as a pollution abatement measure; but, not without an important public relations value, and a fair recovery on capital costs.

Then, at the Purdue Industrial Waste Conference the outstanding undertaking of American Maize Products Co. at Roby, Ind., reported upon by Messrs. Van Patten and McIntosh, has involved an expenditure of $850,000 to provide effective pollution abatement, which has also yielded a worth-while reduction of unrealized product losses.

Industry is learning much to its pleasant surprise that the financial shoe in pollution abatement is not pinching as hard as anticipated. The agreeable surprise is that, with internal plant improvements, waste treatment is not costing what had been anticipated. Others are learning that recovery systems are yielding unexpected quantities of marketable products to materially reduce the overall cost to a figure not anticipated when entering on the undertakings. Still others are finding that the original cost estimates, based on laboratory experiments (and even pilot plant operation in some instances) have been considerably more than experienced in full plant scale operations. Furthermore, treatment process efficiencies have exceeded expectations after further experimentation in operation of the full scale treatment facilities—all of which is good news and encouraging to those who harbor fears of costs *beyond*, rather than less than, original estimates.

We concur in the reasoning of Lyman Cox, chairman of M.C.A.'s Pollution Abatement Comm., that more publicity should be given to the accomplishments in pollution abatement. We also concur in his opinion that reports to the public which indicate attainments in pollution abatement in terms of reductions in "population equivalent," or any other technical terms, is not the most effective method. Instead, the public at large, as well as others, can more readily appreciate expenditures in dollars for pollution correction as the indication of what any one company or industry is doing to meet the growing public demand for purer air and cleaner waters.

A Court Decision of High Import

Water quality control authorities, and all interested in cleaner streams in America, have much to be grateful for in the recent declaration of the U.S. Supreme Court, in its unanimous decision, that the State of West Virginia is legally bound in the eight-state Ohio River Compact, which was entered into for the purpose of securing pollution abatement on the Ohio River and all its tributaries.

The U.S. Court's decision reverses the ruling of the West Virginia Court of Appeals (State Supreme Court) in its declaration that participation by West Virginia, and proportional payments in financing the work of the Ohio River Valley Sanitation Commission, was unconstitutional. This, on the grounds that the Compact required West Virginia to incur a financial obligation in violation of constitutional debt limitations. Further, that the State could not delegate to the Commission police powers contrary to the general principles of constitutional law.

The U.S. Court, however, holds that "a state can not be its ultimate judge in a controversy with a sister state" . . . "this compact involves a reasonable and carefully limited delegation of power to an interstate agency" and states that "this compact evidently was drawn with great care." And further, "that adjudication of conflicting state interests affecting stream pollution does not rest upon the law of a particular state. A compact such as this is, after all, a wholly legal document."

Edward J. Cleary, executive director and chief engineer for the Ohio River Commission, received this all important decision, in the interest of all stream control compacts and pollution control interests, with the pertinent statement that "this decision gives strength and prominence to pollution abatement programs in general, and permits a confidently vigorous extension of our own program."

L. H. Enslow

MAXIMUM REMOVAL

CLEAN GRIT

NO MECHANISMS

Chicago

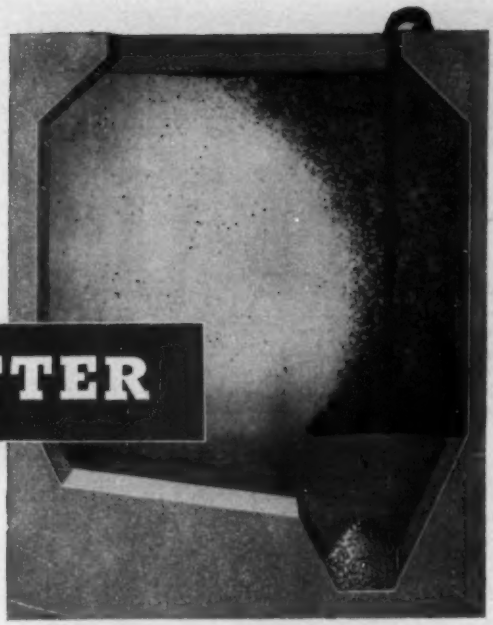
AER-DEGRITTER

AIR CONTROLLED VELOCITIES

INDEPENDENT OF FLOW

LOW COST

SIMPLE STRUCTURE



The 'Chicago' Aer-Degritter now provides the only method of removing grit and sand from sewage without movable mechanical equipment. Air introduced through 'Chicago' Swing Diffusers and Precision Diffuser Tubes controls the velocity of the flow. All sand of 0.2 mm. (65 mesh) and larger is washed and deposited in a hopper at the bottom of the tank.

Analysis of grit removed by this system shows less than 10% volatile matter and only a negligible trace of putrescible organics. Because coarse sewage material will not interfere with the operation of the Aer-Degritter and because it does not affect the hydraulic design of the plant, Aer-Degritters may be installed ahead of all mechanical equipment.

'Chicago' Aer-Degritters have been operating successfully at Oildale, California; Columbus, Ohio; Tomah, Wisconsin; and Bellaire, Texas. Additional Aer-Degritters are being installed in Sedalia, Missouri; Ann Arbor, Michigan; Jasper, Indiana; and Fort St. John, B. C., Canada.

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SEWAGE EQUIPMENT DIVISION

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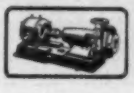
Flush Kleen, Scru-Feller, Plunger, Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers.



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Precise determinations are performed in the ranges of zero to 150 p.p.m. SiO_2 and zero to 100 p.p.m. SO_4. Higher values are determined by diluting the specimen.

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- TRENCHES
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Meetings Scheduled:

May 15-16—Vancouver, B.C., Canada *(Hotel Vancouver)*
PACIFIC NORTHWEST SEWAGE WORKS ASSOCIATION. Sec'y, Wm. P. Hughes, City Hall, Lewiston, Idaho.

May 17-19—
PACIFIC NORTHWEST SECTION A.W.W.A. Sec'y, O. P. Newman, Boise Water Department, Boise, Idaho.

May 17—Manchester, N.H.
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos. C. Knox, 73 Tremont Street, Boston 8, Mass.

May 17-18—Ocean City, Md. *(Commander Hotel)*
MARYLAND-DELAWARE WATER & SEWERAGE ASSOCIATION. Sec'y, W. McLean Bingley, 2411 North Charles St., Baltimore 18, Md.

May 21-23—Winnipeg, Man., Can. *(Alexandra Hotel)*
CANADIAN SECTION A.W.W.A. Sec'y, Dr. A. E. Berry, Ontario Department of Heath, Parliament Building, Toronto, Ont.

June 4-5—Grand Rapids, Mich. *(Hotel Pantlind)*
MICHIGAN SEWAGE & INDUSTRIAL WASTES ASS'N. Sec'y, Donald M. Pierce, State Dept. of Health, Room 334, Administration Bldg., Lansing 4, Mich.

June 7-8—Springfield, Mass. *(Hotel Kimball)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTE ASS'N. Sec'y, Walter E. Merrill, State Dept. of Health, 511A State House, Boston, Mass.
(Joint Meeting)
NEW YORK SEWAGE & INDUSTRIAL WASTES ASS'N. Sec'y, Ralph C. Sweeney, 21 N. Broadway, White Plains, N. Y.

June 11-14—Tuscaloosa, Ala. *(University of Alabama)*
ALABAMA WATER & SEWAGE WORKS SHORT SCHOOL, Director, Prof. G. H. Dunstan.

June 15—
ALABAMA WATER & SEWAGE WORKS ASSOCIATION. Sec'y, Alex O. Taylor, Box 69, Auburn, Ala.

June 13—York Harbor, Me. *(Joint Conferences)*
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earl A. Tarr, Winthrop, Me.
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos. C. Knox, 73 Tremont St., Boston, Mass.
NEW HAMPSHIRE WATER WORKS ASSOCIATION. Sec'y, W. A. Healy, 17 Capitol St., Concord, N.H.

June 18-22—State College, Pa. *(Pennsylvania State College)*
FOURTH ANNUAL WATER WORKS SCHOOL. Director, R. Rupert Kountz, Dept. Civil Engineering, Pennsylvania State College, State College, Pa.

June 20-22—Columbus, Ohio *(Neil House)*
OHIO SEWAGE AND INDUSTRIAL WASTES TREATMENT CONFERENCE. Sec'y, J. E. Richards, 302 Departments Bldg., Columbus 15, Ohio.

June 25-29—State College, Pa. *(State College, Pa.)*
FOURTH ANNUAL SEWAGE WORKS SCHOOL. Director, R. Rupert Kountz, Dept. Civil Engineering, Pennsylvania State College, State College, Pa.

June 29—Trenton, N.J. *(De Laval Steam Turbine Plant)*
NEW JERSEY SECTION A.W.W.A. (Summer Meeting.) (Inspection Trip and Luncheon.) Sec'y, C. B. Tygert, Box 178, Newark, N.J.

Aug. 20-22—Toronto, Ont. *(Royal York Hotel)*
CANADIAN INSTITUTE ON SEWAGE PURIFICATION. Sec'y, A. E. Berry, Parliament Buildings, Toronto, Ont.

Aug. 20-22—State College *(Nittany Lion Inn)*
PENNSYLVANIA WATER WORKS OPERATORS' ASSOCIATION. Sec'y, R. Rupert Kountz, Penna. State College, State College, Pa.

Aug. 22-24—
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, B. S. Bush, Dept. of Health, Kirby Health Center, Wilkes-Barre, Pa.

Sept. 10-12—Boston, Mass. *(Hotel Statler)* NEW ENGLAND WATER WORKS ASSOCIATION (Annual convention). Sec'y, Jos. C. Knox, 73 Tremont Street, Boston 8, Mass.

Oct. 8-11—St. Paul, Minn. *(Municipal Auditorium)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSN'S. (Annual Convention) W. H. Wisely, 325 Illinois Building, Champaign, Ill.

Impact Insurance Against

1—LOSS OF FIRE PROTECTION.

2—EXCAVATION AND PAVEMENT REPLACEMENT.

3—COSTLY REPAIRS INVOLVING MAJOR HYDRANT COMPONENTS.

4—FLOODING.

The Smith Protectop Hydrant is designed to permit rapid return to service at minimum cost when a Hydrant is damaged as a result of a traffic accident.

The Protectop Hydrant Standpipe and Valve Stem are equipped with *Special Couplings* located just above the ground. The Couplings withstand operating pressures and ordinary impact with an ample factor of safety. Under excessive impact occasioned by traffic accidents the Couplings fracture at the design points thus minimizing the damage and permitting speedy return to service at low cost.

All Smith Hydrants are equipped with *Compression Type Valves* which definitely eliminate flooding since the line pressure holds the Valve against its seat in the closed position.

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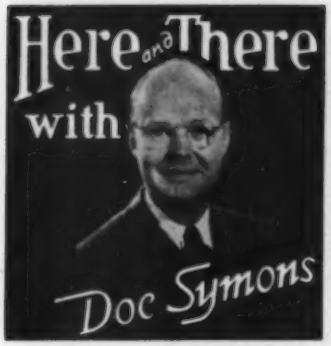
EAST ORANGE, NEW JERSEY



Here's That Man Again—And it's May again—Need I say more?—But I am going to say more, and here it is.

* * *

One thing I like about Don Bloodgood (besides his friendship and his ability as a Prof. of San Engineering at Purdue) is the fact that he never slugs me for those fantastic stories I tell about him.—But this one he told on himself—it really happened.

Don's son, a student at Purdue, owns a 1927 Ford in a state of somewhat disrepair. One day, Don, finding that Margaret, his wife, had the family car and he being in dire need of transportation, borrowed the '27 Ford.

He was stopped for a traffic light a few minutes later. Just before the light turned green, he overheard two Purdue female students commenting on the car. After an appropriate remark, one of them added, "And I'll bet he still has the first nickel he ever earned."—

Don, you know hails from Wisconsin and like all "Badgers" has a cousin from Milwaukee—This one turned up at the Federation meeting in Washington—her name is Mary Konrad; Gawrge! Is she a looker? —Her hubby is part of the Chain Belt gang—Lucky boy!!!

* * *

If you haven't seen the motion picture, "Air, Water and Industry," I suggest you write to Tom Powers. Waste Disposal Supervisor, Dow Chemical Co., Midland, Mich. This movie, produced by the Dow Chemical Co., is the best I've ever seen—and I have a hunch that Tom Powers deserves much of the credit.

* * *

HAT'S OFF DEPT.—To C. A. (Charlie) Emerson, longtime President and Wheelhorse of the Federation, Consulting Engineer par excellence, and swell guy—for his recent successful battle with ulcers. Charlie had just thrown away his cane, now that cortisone had licked his arthritis, when ulcers hospitalized him. A bit of surgery, and you'll be seeing him around the meetings again.

* * *

KIT'S KARICATURES

* * *

Well What Do You Know Dept.! —The "Senator" from Infilco, Fred

(Continued on page 76A)

THE LONG RANGE VIEW IS IMPORTANT, TOO!

when buying or specifying chlorine gas feeders

In other words, how will the chlorinator stand up under continuous use?

Here's where BUILDERS VISIBLE FLOW CHLORINIZERS shine. Due to their unique design, these chlorinators meter and control chlorine gas in the dry, non-corrosive state. Dry, non-corrosive gas as it comes from the cylinder is regulated, controlled, and metered before it enters the bell jar where it first comes in contact with water. As a double protection, the chlorine control valve is lined with porcelain enamel and has a Tantalum diaphragm with silver valve seat and needle — materials that are completely unaffected by dry chlorine gas and highly resistant to moist chlorine gas.

Another feature is the unitized construction of Builders Chlorinizers. These chlorinators are built of separate assemblies . . . simple, integral units — easy to maintain, easy to replace. For complete information and Bulletins, address Builders-Providence, Inc. (Division of Builders Iron Foundry), 350 Harris Ave., Providence 1, R. I.

BUILDERS PRODUCTS

The Venturi Meter • Propelofio and Orifice Meters • Kennison Nozzles • Venturi Filter Controllers and Gauges • Conveyoflo Meters • Type M and Flo Watch Instruments • Wheeler Filter Bottoms • Master Controllers • Chlorinizers — Chlorine Gas Feeders • Filter Operating Tables • Pneumatic Meters • Chronoflo Telemeters

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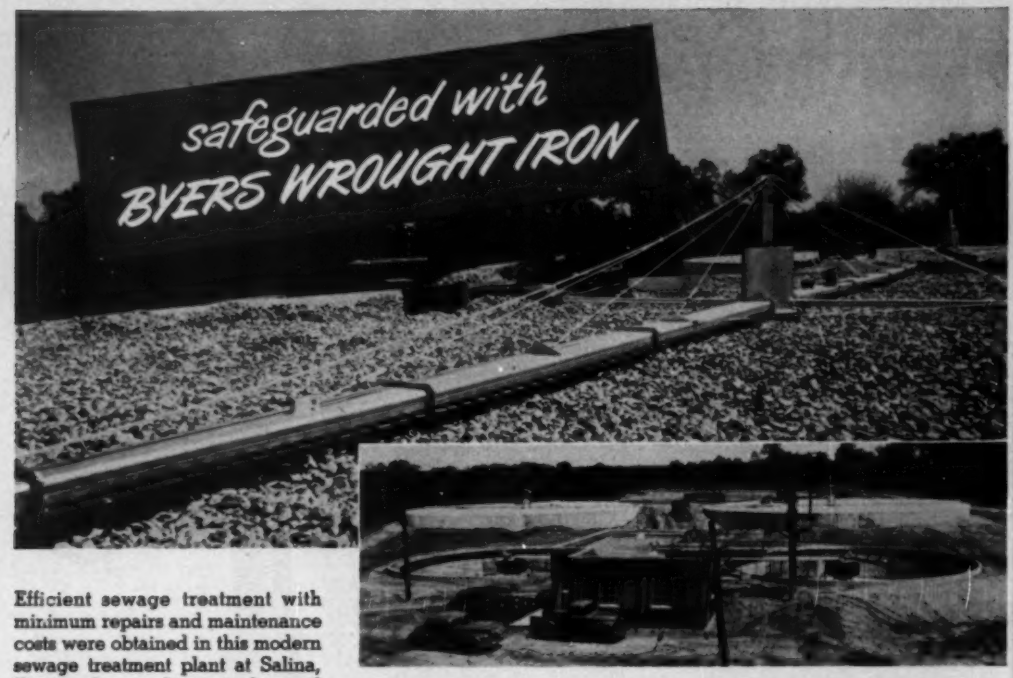
BUILDERS-PROVIDENCE

BUILDERS

7 VITAL SERVICES in this modern sewage plant



Efficient sewage treatment with minimum repairs and maintenance costs were obtained in this modern sewage treatment plant at Salina, Kansas, by combining advanced engineering principles with sound material selection. In seven services where corrosive action is most severe, the engineers specified time-tested wrought iron. Byers Wrought Iron was used for weir plates, scum baffle plates, scum troughs, distributor arms, all gas piping, vertical heat exchanger coils, and all hot water heating piping. Wilson & Company, Engineers, of Salina, Kansas, designed and supervised the construction, Brown and Johnson, Salina, Kansas, were the contractors. Dorr Company supplied the heat exchangers and distributor arms as a part of the necessary equipment.

The selection of wrought iron for these punishing services follows accepted design practice, and is endorsed by performance records that testify to wrought iron's superior corrosion resistance. Engineers have applied wrought iron to practically every "hot-spot" in modern plants. The record speaks for itself.

If you are concerned with the construction of a new sewage treatment plant, or the maintenance of an old one, you will find some helpful information on how to reduce repairs and save money in our bulletin, WROUGHT IRON FOR SEWAGE TREATMENT AND DISPOSAL INSTALLATIONS. We'll be happy to send you a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.

WHY WROUGHT IRON LASTS

This notch-fracture test specimen illustrates the unusual fibrous structure of wrought iron—which is responsible for the unusual corrosion and fatigue resistance of the material. Tiny fibers of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

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CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

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ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

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ALL WINDINGS IN

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No motor is more durable than its windings. In *U. S. Uniclosed Motors* all windings are asbestos-protected. Motor life is tremendously increased because asbestos cannot carbonize and withstands highest temperatures.

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Beautiful contouring of the armored Uniclosed surface adds eye appeal and product sales advantage. Other U. S. features – Lubriflush lubrication, normalized castings, centricast rotors, dual ventilation.

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Send U. S. Uniclosed Motor Bulletin featuring asbestos-protected windings.

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(*Continued from page 74A*)

Eidsness, is going back to school—this time in pursuit of the degree of Doctor of Philosophy. Yep—for the next couple of years or so the big breezy boy with the tall tales will devote his energies to study at the Univ. of Florida in Gainesville.

Ah me, if he turns out to be another professor, I'll lose a good piece of copy—(Remember when George Schroepfer of Minneapolis turned Prof. at the Univ. of Minn. and promptly disappeared from this column, darn it.)—And I've got such a good story on Fred and Judy Eidsness at the Boston meeting of the Federation in '49.—Wonder if I'll ever get to use it?

* * *

Do you recall in the March column a picture of Ralph E. Fuhrman, Federation Prexy? I labelled it, "WANTED—a caption for this picture."

I got one from Walter H. Cates, Mgr., Hydraulics Div., Consolidated Western Steel Corp., Los Angeles. Cates suggested—"So There You Have It, Friends, In A Nutshell."—Any other suggestions?

* * *

On the last morning of the Fed. Meeting I learned that Phil Kavanaugh (the W. & T. Boy from down southway) is a master of art of double talk. He can entertain you by the hour with impossible words put together to sound like real talk. Some convention ought to hire him as an act some time—He's really good.

* * *

Jim Brown, of the Chicago Jim Browns, formerly of National Water Main Cleaning and Trojan Tool Co., and now with Centriline, showed up at the N.Y. Sect. meeting and I learned that Seaver Jones was retiring as President of Centriline.

* * *

Many of you will remember "Jimmy" Angell, who left this field to go into the heavy construction field and is now Business Manager of *Construction Equipment*. Seems he can't forget the water works game entirely, for one day recently, I received a newspaper clipping from him. It was about a fellow many of you know very well—R. C. Willson (with two ells), Water Superintendent at Hagerstown, Md.

This is the story—A customer barged into Dick's office and complained long and loud about an acid condition in his stomach, caused, positively, "by the fluorine which was being added to the water." If the city would only stop putting fluorine

(*Continued on page 79A*)

EXPAND with...

EDDY HYDRANTS

Mechanical Joint Connection Cuts Installation Time...

Since 1849 EDDY For Long Service

Eddy Hydrants open smoothly *with* the pressure ...have large, clear waterways to insure plenty of water... close without water hammer. Stem held in place below main valve means no water loss due to bent stem. Positive drip action drains barrel when hydrant is closed —prevents freezing. One man can remove all operating mechanism easily for inspection or repairs. Expand now, to meet any emergency—with Eddy Mechanical Joint Hydrants! Can be installed in any weather, or in a flooded trench. A ratchet wrench is the only tool needed.

Send today for descriptive literature.

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Towns and cities of all sizes throughout the United States are regular users of McDONALD Waterworks Brass. For 95 years the McDONALD Diamond has meant "Uniform Top Quality". Shown above is E-4701 corporation stop with various type adaptors and 3 part copper coupling.

An illustrated brochure with detailed specifications showing our complete line of Waterworks Brass will be sent to you promptly on request. A. Y. McDonald Mfg. Co., Dubuque, Iowa.

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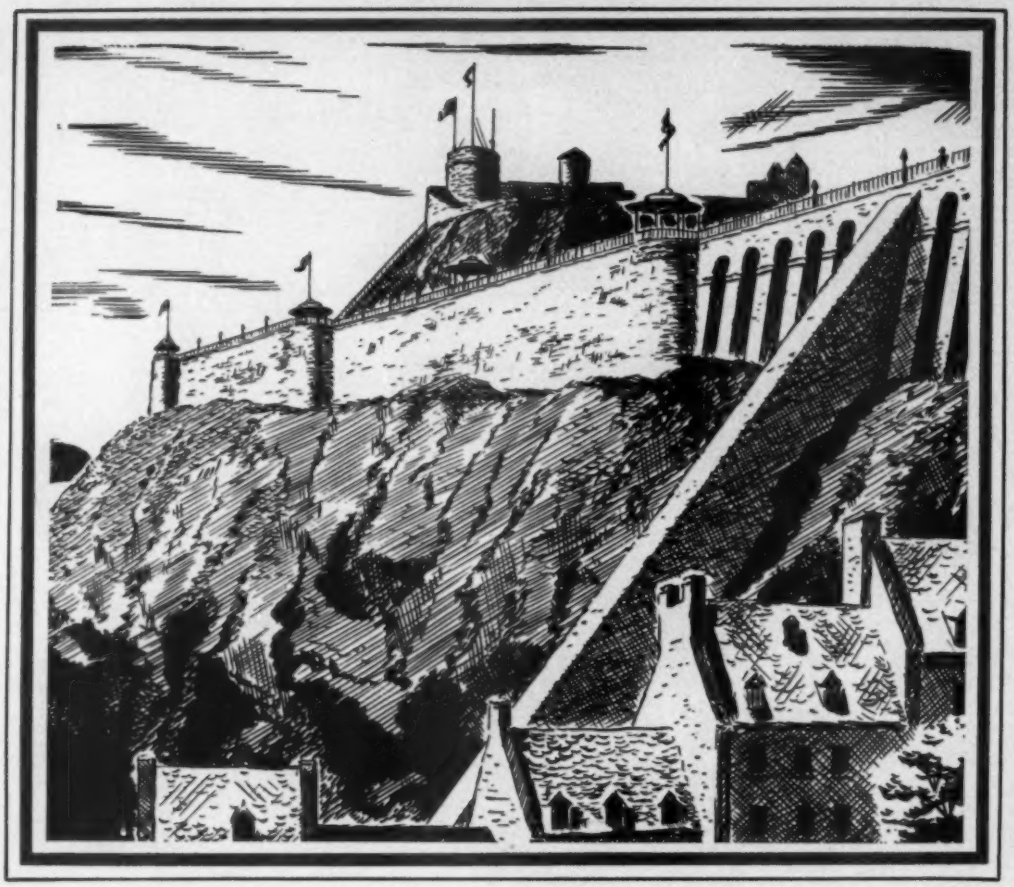


Quebec's famous Citadel, over 330 feet above the St. Lawrence, as it looked 100 years ago

Romantic Quebec has a cast iron gas main in service that was installed over a century ago. Reminiscent of those days are the horse-drawn vehicles for nostalgic tourists. Now, how could the gas engineers have foreseen the advent of trailer-trucks and giant buses, and the resultant traffic-shock?... That sewers and conduits for utility services would ultimately share the underground at risk of soil disturbances? Yet that gallant old cast iron main has had the necessary shock-strength and beam strength. Effective resistance to corrosion, as well as strength, are *must* factors of long life in pipe to be laid under city streets. This is shown by the fact that cast iron water and gas mains, laid over 100 years ago, are still serving in the streets of more than 30 cities in the United States and Canada.

United States Pipe and Foundry Co.,
General Offices, Burlington, N. J.
Plants and Sales Offices Throughout the U. S. A.

U.S. PIPE

NUMBER FIVE OF A SERIES

(Continued from page 76A)

into the water his stomach would not be in such bad shape.

I would like to have seen the expression on that fellow's face when Willson told him that there was no fluoride being added to the water, had not been, and would not be. If and when, they do add fluoride, Dick says, he won't tell the public if that's the reaction he's going to get.

* * *

One of the features of the Washington Meeting of the Federation was a tour of the city for the ladies and a tour of sewage plants for the men. I am not quite sure but I think the bus drivers had received coaching from Ralph E. Furham (new FSIWA Prexy) on how to keep your audience laughing. Many of the ladies will long remember the bus driver who, as they passed the Atomic Energy Comm., mentioned the experiments with radar etc. and said, "If you will put your hand against the window as we pass, you will feel a little pane.—Most of them did, I am reliably told.

To me, however, the best crack by the bus driver with whom I rode (and he made dozens of them; many good) was when we started out and were just passing the Treasury Bldg. about which he said, "This is the Treasury Dept.; it is no longer important—The gold is in Ft. Knox, the silver is in West Point and the money is in Europe."

* * *

This newspaper clipping was handed me in Washington—It was from the Oshkosh B'Gosh, Wis. paper—To wit:

"Removal of the chimney at the Badger Lumber Mfg. Co. will also result in the removal of a long standing sign in the office of Robt. W. Frazier, Supt. of Sewage Treatment. Strange as it seems, these apparent incongruous statements are definitely related.

"The 100 ft. chimney had taken the form of the Leaning Tower of Pisa and the lean was quite noticeable from Frazier's office.—So many persons looked out of Frazier's Window and gasped that he put up the sign—

"You're not cockeyed—the chimney is—!"

* * *

In response to my comment in the March column, that I had written 91 of these "letters" to my readers, Art Kuranz, "Waukesha's Water Willie" wrote as follows:

"It seems longer than 91 letters ago that you started, and on the other hand, it's taken me about 91

Keep your eye on V·P·L
WHEN SELECTING
BLOWERS

CENTRIFUGAL

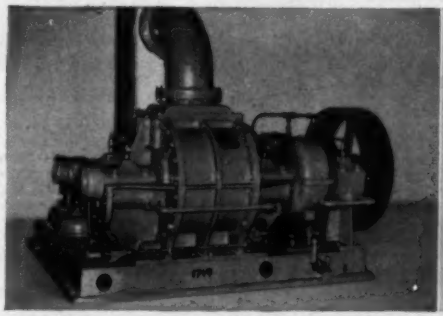
This Type H, 3-Stage Centrifugal Blower, with capacity of 15,000 cfm, is one of many R-C units used by this large eastern city in sewage treatment service.

Sewage treatment plants can't afford to risk shutdowns because of unsatisfactory or inadequate equipment performance. To maintain required rates of flow, calls for blowers that continuously deliver positive Volume at required Pressure—and at Low power costs to reduce operating expense.

You get these 3 essentials from R-C Blowers. Whether your needs call for Centrifugal or Rotary Positive units, we can match them from our exclusive *dual-ability line*. With capacities from 5 cfm to 100,000 cfm, you can usually find R-C units that closely fit your demands, with resultant savings in time, cost, space, weight and power.

From an experience of almost a century of blower building, our engineers will gladly make suggestions of the right R-C equipment for industrial or municipal sewage treatment plants of any size.

ROOTS-CONNERSVILLE BLOWER CORPORATION
510 Mount Avenue, Connersville, Indiana



ROTARY

Type RCDH Rotary Positive Blower installation in sewage treatment plant in central New York City. Capacity 2,000 cfm.

ROOTS-CONNERSVILLE
BLOWER BUILDERS SINCE 1854
ONE OF THE DRESSER INDUSTRIES

letters to really begin to read and enjoy them. . . . I trust you don't get any crazy notions in your head that you have to give up writing them."

Thanks for the kind words, BUT, if it takes 91 "Letters" to develop a reader's interest, then I'm a dead pigeon as a columnist.

* * *

It's a dark and rainy day, as I write this column; the kind of day that often leads to somber thoughts. —And I must confess I have one. I recently had occasion to look over last year's annual index of *Wat. & Sew. Wks.* and I came to the entry "Deaths." Each year that entry gives me pause for there I see recorded the names of some 8 to 12 well known persons in the field of water purification and sewage treatment. I am conscious, not only of the great loss to the industry, but many times it is the loss of a strong personal friendship.

All this makes me mindful, too, of the importance of Vic (AWWA Prexy) Weir's plea for more young men in this field. We are not growing younger, and statistics are catching up with us. That's why I think it behooves all of us, this column included, to publicize the opportunities in this field.

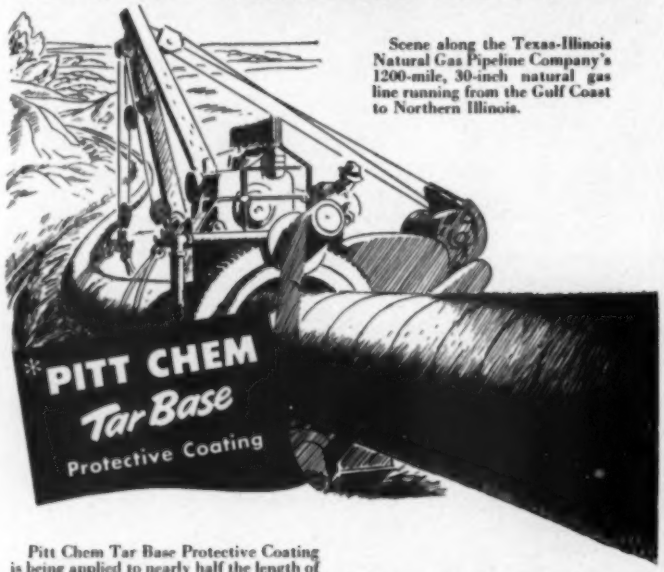
On the brighter side—I'm glad to see young fellows like Charlie Mebus joining the consulting engineer firm of his father George Mebus in Glenside, Pa. And then there's Gene Schwandt of the Worthington Pump & Machinery Co., Mike Kachorsky, Supt. of Sewage Treatment of Manville, N.J.; Ted Rudgal, recently of Kenosha, Wis., now head man of the Gary, Ind., Water Works; Dave Backmeyer, Supt of Water and Sewage at Marion, Ind.; "Jimmy" Meyers, of Philadelphia Suburban Water Co.; Paul Weir, Gen. Mgr. of the Atlanta Water Works and "Bill" Hust, of Winnipeg, Man., and the youngest city engineer anywhere.—Maybe if we give some of these young go-getters a little publicity, others will come in. How about you readers sending me a few names of promising young "fellers" in the business.

* * *

Time to say goodbye for this month. Next month we'll finish up a few odds and ends and then start on the story (and stories) of the Miami AWWA Convention.

V.T.Y.—Doc.

*Life-Saving "Skin"** for another **BIG INCH** pipeline



Scene along the Texas-Illinois Natural Gas Pipeline Company's 1200-mile, 30-inch natural gas line running from the Gulf Coast to Northern Illinois.

Pitt Chem Tar Base Protective Coating is being applied to nearly half the length of the new steel pipeline that will soon carry gas from the Corpus Christi area to Joliet, Ill. It's one of the basic materials of a tough, metal-preserving sheath that will guard against underground corrosion and add years of life to the vital line.

This reinforced tar base coating provides more than just "life insurance" for this $120,000,000 transportation system. Because of its unvarying top quality—maintained by painstaking laboratory control—Pitt Chem pipeline coating performs better on application, serves better and longer underground.

This same *quality-assurance* is an important advantage when you use any of Industry's Most Comprehensive Family of Protective Coatings . . . whether it's a Pitt Chem Alkyd, Chlorinated Rubber, Vinyl or Phenolic base coating. For more information about these versatile, equipment-saving coatings, send for booklet, "Control Corrosion Through Pitt Chem Protective Coatings."

Protective Coatings Division

PITTSBURGH COKE & CHEMICAL CO.

GRANT BUILDING, PITTSBURGH 19, PA.

WAD 5501

OFFICES: NEW YORK • CHICAGO • ST. LOUIS • TULSA • HOUSTON • LOS ANGELES • SAN FRANCISCO

The Spillway

(Overflow From The Main Section)

Milwaukee Takes Bids on Fluoridation Equipment

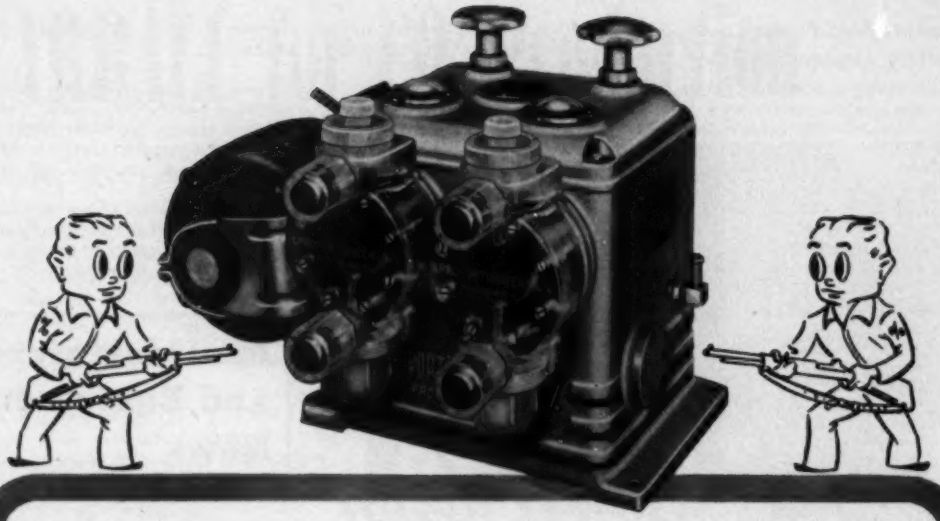
On March 30th Milwaukee opened bids covering equipment and accessories for adding fluorides to the city water. The low bid was $37,900, submitted by the L. R. Schmaus Co., a plumbing contracting firm of Milwaukee. Other bids ranged from $38,674 to $40,943.

The contract calls for completion of the installation within 60 days after starting of the work and it is the intention to begin fluoridation of the Milwaukee water supply on or before Oct. 1, 1951.

The Milwaukee Fluoridation Plant will be the largest in the world to date and will be the 37th in Wisconsin.

Addenda: The following advice has been received just as we are going to press.

"The Commissioner of Public Works has decided to reject the bids of March 30th, and has decided to advertise for equipment, with the installation to be made by the city's forces."



GUARD YOUR WATER SUPPLY—

In normal times or in times of emergency, you can count on %Proportioneers% Heavy Duty CHEM-O-FEEDER. Look at the important advantages which make Chem-O-Feeder the sure way to safeguard water supplies:

1. All parts coming in contact with treating chemicals are of See-Thru plastic and Neoprene rubber which are unaffected.
2. Alum, Ammonia, Copper Sulphate, Hypochlorites and Fluorides can be fed by standard units.
3. Pumping action is visible to the operator.
4. This feeder has the widest dosage adjustment range and changes may be made "in operation".
5. Compact construction encloses all moving parts in oil bath requiring no lubrication maintenance.
6. Accessories for complete installation included with feeder.
7. Parts for all models are in stock at strategic service centers.
8. Feeder can be readily converted to slurry feeding or the handling of concentrated corrosive liquids.

Write, today, for Bulletin SAN-7, the complete story on Simplex, Duplex, and Triplex Chem-O-Feeders. %Proportioneers, Inc.%, 350 Harris Ave., Providence 1, R. I.

% PROPORTIONEERS, INC. %

Excerpts from Purdue's Sanitary Engineering News*

Laboratory experiments pertaining to some factors which may affect scum formation in digesters indicate that the forces responsible are mainly physical in nature. Lighter materials separate from the sludge, float, compact with time, resulting in drying and increase in concentration of the scum, which in turn retards digestion. Mixing of the scum with ripe sludge speeds up digestion, hence mixing and soaking devices alleviate scum accumulation. Certain chemicals may aid in softening the scum, retard concentration and aid digestion.

*Edited by Prof. Don E. Bloodgood.

In a study, to determine the dissolved oxygen of sewage actually falling into a trickling filter, it was found that there is zero dissolved oxygen at one-foot distance from the fixed nozzle.

A commercial-sized grinder was used in a Houston, Texas, egg cracking plant as a method of disposal for egg shells. The resulting ground material, upon discharge to the sewage, clogged building plumbing and city sewers.

Assuming no lessening of the rate of urban population increase during the next century the water works industry must prepare to meet the needs of 500,000 new consumers each year.

It has been found that synthetic detergent pollution has considerable effect upon the quantity of chemical required in the coagulation of surface water.

M & H Mechanical Joint
IBBM AWWA Gate Valve

Purchase price (or first cost) of a valve is not its real cost. Maintenance engineers appraise the true cost of a valve as cost per year of service—i.e., purchase price plus maintenance costs divided by years in operation.

On that basis, M & H likes comparison because M & H Valves are designed to last longer and entail little or no maintenance cost. Sizes 2 to 30-inch, with all end connections, including Mechanical Joint as shown.

Installing M & H Mechanical-Joint Valves into an existing pipe line is easily and quickly done by common labor with Mechanical Joint Cutting-In Sleeves. The job of regular inspection and maintenance of fire hydrants is also greatly simplified if auxiliary valves are installed for each hydrant, and an M & H Mechanical-Joint Valve makes such a job an easy one.

MECHANICAL JOINT
CUTTING-IN SLEEVE

M & H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

M&H PRODUCTS Everywhere

Manufacturers' and Equipment News

New Fluoride Feeder by Wallace & Tiernan

501

Wallace & Tiernan exhibited their new precision feeder, especially designed to feed fluorides, at the recent A.W.W.A. Convention in Miami.

Known as the W&T Series A-635, this newest of precision chemical feeders is available as either a volumetric or a gravametric feeder. The latter automatically precludes overfeeding by control on the basis of loss-of-weight of chemical in the hopper.

The Series A-635 Fluoridator features a specially designed two-directional screw feed mechanism, as well as an over-sized solution pot with a built-in agitator and automatic eductor. Thus is ensured complete solution

(Continued from page 84A)

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

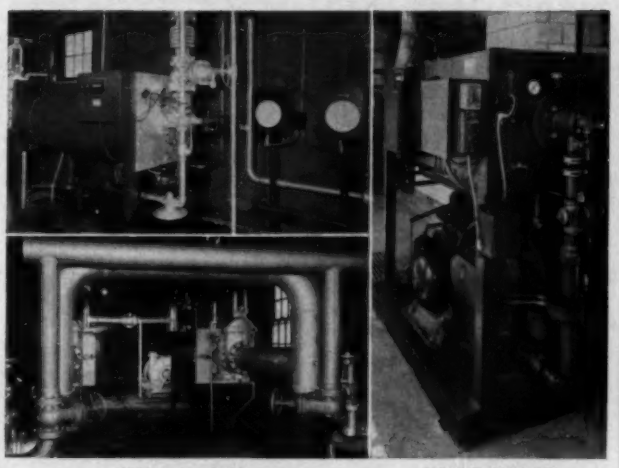
CARBALL for CO_2 Production

CARBALL FUNCTION

The CARBALL is the most efficient package carbon dioxide producer yet developed. It produces clean CO_2 gas for slightly over 1/2 cent a pound. The chemical efficiency from total carbon to alkalinity change is 92%! Accordingly, it will carbonate water for approximately 1/2 of the fuel consumption of other types of systems.

The burner receives fuel and air under pressure, so that gases leaving the producer are under pressure for self injection. The air compressor handles only cold air. Water jacket cooling water is available for lime slaking. Because the Carball unit burns gas or oil under a very high temperature (2600°F) there is no condensable carbon remaining and a clean tasteless CO_2 gas is obtained which doesn't require scrubbing before use.

Since the CO_2 gas is under pressure from the burning chamber, the disadvantage of the older systems wherein the hot, corrosive gas was compressed is avoided. This amounts to a considerable saving in the size of and maintenance on the compressor.

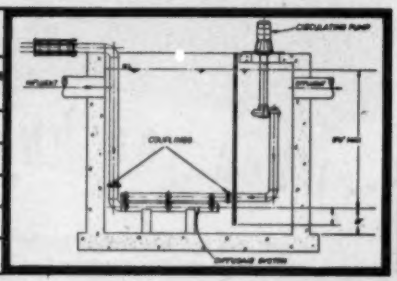


COLUMBUS, OHIO — MOLINE, ILLINOIS

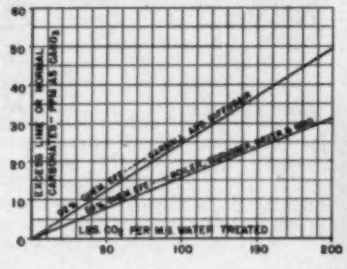
TABLE SHOWING CAPACITIES AND SIZES OF UNITS

	OIL — No. 3			GAS — NATURAL				DIMENSIONS			
Size	Pounds CO_2/Hr	cfm 14.5% CO_2	Oil gph	Pounds CO_2/Hr	cfm 10% CO_2	cfh of Gas	Water GPM	Length	Width	Height	Outlet Size
No. 0	20	20	0.9	13	20	120	3	6'-9"	20"	50½"	3"
No. 1	58	60	2.6	39	60	360	3	6'-9"	30"	54"	4"
No. 2	116	120	5.2	78	120	720	6	8'-6"	36"	60½"	6"
No. 3*	231	240	10.3	155	240	1440	12	12'-4"	38"	68½"	10"
No. 4*	576	600	25.7	390	600	3600	25	On Application			12"

*Blower (and gas booster if used) mounted separately on Size No. 4 units and on Size No. 3 units above 150 cfm.



Curves showing CO_2 requirements at 92% chemical efficiency in comparison to requirements when using older, less efficient methods.



DIFFUSAIR FUNCTION

The DIFFUSAIR is a most efficient device for diffusion of CO_2. CO_2 bubbled at 4 cfm from the center of each bronze cavitation dish is diffused into bubbles of dust-like fineness. The diffusion apparatus not only eliminates corrosion and the progressively poorer absorption obtained from an old fashioned grid system, but occupies only a small fraction of the latter's basin requirement; using only basin size for 1/2 minute of flowing-thru capacity and 8 feet of water depth.

WRITE FOR BULLETIN 7542

WALKER PROCESS EQUIPMENT INC.

PROQUIP PROCESS EQUIPMENT

FACTORY · ENGINEERING OFFICES · LABORATORY

AURORA · ILLINOIS

(*Continued from page 82A*)

and maintained uniformity of feed of the less expensive but less soluble sodium silico-fluoride, as well as the more highly soluble sodium fluoride.

The basic feeder is a volumetric feeder which is manually adjusted for a given feed rate. Or the volumetric feeder may be obtained with a built-in scale for periodic manual checking of the weight of chemical remaining in the hopper. Thus, the volumetric feeder can be calibrated as a loss-of-weight feeder.

The full gravimetric (loss-of-weight) feeder, differs from the volumetric arrangement described above by the inclusion of controls operated from a special scale beam within a dust tight enclosure. The travel of a weight along the beam controls the rate of discharge of chemical from the hopper of the fluoridator on a weight output basis.

Three registers on the gravimetric feeder show the rate of feed, the weight of chemical remaining in the hopper, and the total weight which has been fed during any period.

The chart record loss-of-weight recorder attached to the A-635 Fluoridator here pictured is available as optional equipment.

YOU PURCHASE A PROFIT

... when you buy a ROYER

If ever you had a chance to "buy a profit" you have it now. The purchase and operation of a Royer Sludge Disintegrator produces profits for you at once . . . . profits from the reduction in the labor costs of burning, burying or disposing of your sewage sludge cake . . . . plus a regular cash income from the sale of fertilizer.

Sludge cake direct from the sludge beds and containing as much as 56% moisture is shovelled into the hopper of the Royer Sludge Disintegrator, commercial fertilizers added if desired, and the Royer completes the job. The sludge cake is shredded, pulverized and aerated . . . . trash and stones are removed . . . . and a readily marketable fertilizer is discharged direct to truck or bags. Sewage plants everywhere have found a steady demand for this valuable, nitrogen-rich plant food.

Royers are available in many sizes and models. Send for a copy of the Sewage Sludge Datalog giving complete information.

ROYER

PIONEERS IN THE SALVAGE OF SEWAGE SLUDGE

ROYER FOUNDRY & MACHINE CO.

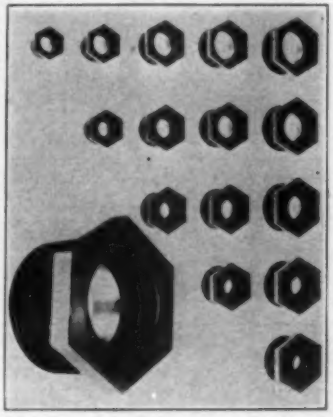
170 PRINGLE ST. KINGSTON, PA.

Cecil Elected Vice Pres. of INFILCO

The Board of Directors of INFILCO, Inc. at its March meeting, elected Lawrence K. Cecil Vice-President. Cecil has been General Sales Manager of the company since August 1950 and has been with Infilco for twenty-five years in the capacity of Sales Engineer and District Manager. Previous to joining Infilco he was affiliated with the Oklahoma State Health Department.

Cecil is a graduate of the University of Illinois and is an active member of the American Institute of Chemical Engineers and American Chemical Society. He has contributed numerous articles to technical publications and has designed equipment for which patents have been issued.

Infilco, one of the nation's leading designers and manufacturers of water conditioning and waste and sewage treatment equipment, has recently moved its headquarters from Chicago to Tucson, Arizona.



Plastic Pipe Reducers & End Plugs

502

Carlon Products Corp., Cleveland, Ohio, has announced the development and production of a new line of injection-molded plastic reducing bushings and end plugs for use with Carlon plastic pipe. The new units feature a hexagonal ring for positive wrench grip to facilitate installation, and they utilize International Pipe Threads.

Carlon plastic reducing bushings are available in fifteen different sizes ranging from 2 x 1½ down to ¾ x ½ inch, and pipe plugs are obtainable in six sizes from 2 inches to ½ inch. Because of the wide range of

(*Continued on page 86A*)

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

Looking for efficient, LOW-COST SCREENINGS REMOVAL?

Immediate, overwhelming acceptance proves new LINK-BELT Thru-Clean Bar Screen the answer for handling screenings from sewage and industrial wastes

YES, 36 new Thru-Clean Bar Screens were sold in the 12 months following Link-Belt's initial announcement! Take a look at the partial list of installations and the consulting sanitary engineers who were responsible for them.

Then look at the advanced engineering illustrated by the photos below. They suggest how this new Link-Belt development can solve the problem of removing screenings from sewage or industrial wastes in your plant.

You can get the complete story by calling your nearest Link-Belt office. Or write for Folder No. 2327.

A FEW USERS OF THRU-CLEAN BAR SCREENS

Location	*Sanitary Engineer*
Nassau County, N. Y.	Greeley & Hansen
Union Grove, Wis.	W. G. Hirchoffer
Port Huron, Mich.	Drury, McNamee & Porter
Idabel, Okla.	Collins Engineering
Storm Lake, Iowa	Buell & Winters
Camden, N. J.	Havens & Emerson
Rochester, Minn.	Toltz, King & Day

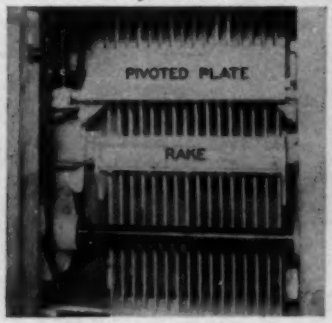
LINK-BELT

SANITARY ENGINEERING EQUIPMENT

LINK-BELT COMPANY: Philadelphia 40, Chicago 9, Indianapolis 6, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in principal cities. 12,350

How rakes automatically clean bars "from the back"

Segmented steel rake is about to start its low-friction vertical movement. Entering from downstream side (*shown*), its forward and upward force precludes jamming or clogging. Travel starts at lowest point of channel, catches all solids retained by screen.



Cold-rolled steel bars, uniformly spaced, form screen. They are rigidly fixed at bottom of channel, extend only 6 in. beyond pivoted plate immediately above high water level. Simple, rugged construction minimizes maintenance. Low speed cuts power consumption.

Hinged wiper blade thoroughly cleans rake fingers, deposits screenings in trough for removal to shredder, disposal can or incinerator. Note the heavy, long-pitch Link-Belt chains, selected for trouble-free long life and assurance of proper travel for rakes.

(Continued from page 84A)

combination sizes available, only one reducer bushing is required to reduce any pipe diameter to any other standard size.

Wm. A. Roberts Elected President of Allis-Chalmers

Allis-Chalmers, Milwaukee, Wis., at a special meeting of the board of directors elected William A. Roberts, executive vice-president since 1947, president of the company. Roberts succeeds the late Walter Geist, who served as president from May 1942, until his death on January 29, 1951.

W. C. Johnson, formerly executive vice president in charge of the general machinery division, was named executive vice president for the entire company.

The board also elected four new vice presidents and made other organization changes.

Two New Senior V.P.s at J-M

Johns-Manville Corp., New York, N.Y., in an announcement by A. R. Fisher, President, stated that William R. Wilkinson has been appointed Vice President for Sales and Kenneth W. Huffine has been appointed Vice President for Production. Both of the new Senior Vice Presidents have been with J-M for the past 26 years.

RELIABILITY

R. D. Wood Gate Valves are especially designed for long underground service.

The well-known reliability of R. D. Wood Gate Valves is a direct result of their simplicity—the absence of parts that could give trouble. There are only three moving members—the spreader and two discs. In opening, the discs are lifted clear of the seats, leaving an unobstructed passage for the flow of water. In closing, they are wedged into place without distortion. No gadgets to go wrong, no pockets to collect scale and sediment.

A smoothly operating system is vital to every community. Let us show you how R. D. Wood Gate Valves make water systems more reliable, at the same time reducing maintenance to the minimum. Send for complete information today.

Seasoned castings. Rigidly inspected. Working pressure up to 175 lbs. Tested to 300 lbs. Conforming to AWWA specifications. Supplied with bell, flanged or mechanical joint pipe connections.

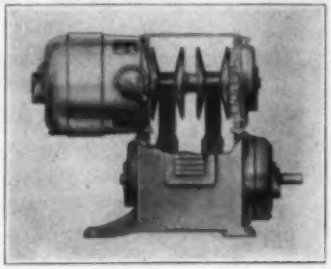
FOR PROPER FUNCTIONING OF YOUR SYSTEM

make sure that all valves are fully opened and closed at least once a year.

R. D. WOOD COMPANY

Public Ledger Building, Independence Square
Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)



Dual Belt Variable Speed Motor

503

U. S. Electrical Motors, Inc., Los Angeles, Calif., has announced the development of a line of heavy duty motors for variable speed ratings as high as 50 horsepower. These are part of the company's Varidrive line.

To carry the heavy load through the internal speed changing transmission, U. S. engineers have incorporated dual varibelts, thus distributing the load so that no undue strain is imposed. To counterbalance belt load, tension control known as Autotaut has been designed. This principle avoids the disadvantages of variable center drives or extra flexing of belts over idlers.

A calibrated spring is employed to maintain pressure between the two halves of the driven varidiscs and the sides of the belt. The spring takes up any slack that might be caused by stretch or wear of the belts. Use of dual belts does not affect the ease of changing motor speeds which is accomplished by merely turning a control dial.

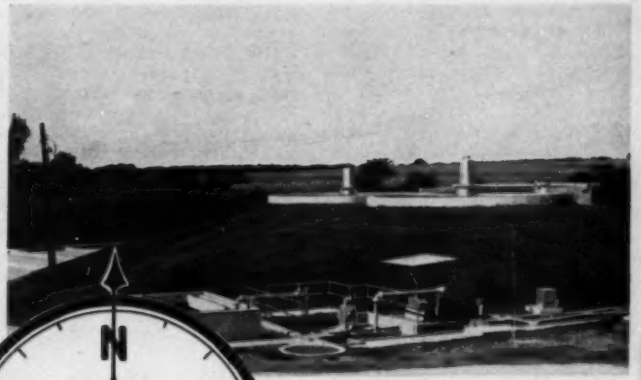
J. V. N. Dorr Again Honored

John Van Nostrand Dorr, Chairman of the Board of Directors of the Dorr Company, Stamford, Conn., has been made a member of the Legion of

(Continued on page 88A)

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

SEDALIA MISSOURI GOES MODERN

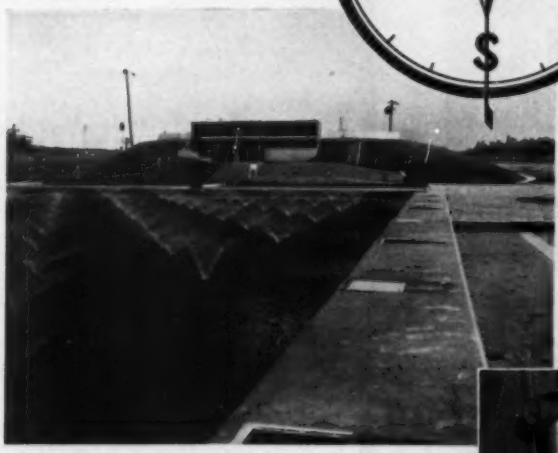


The three waste treatment plants at Sedalia, Missouri—the North, West and South plants—have been completely modernized, utilizing all existing structures and equipment where economies in contruction could be effective.

NORTH PLANT P.F.T. Controlled Digestion System with 2 - 30' floating covered digesters and #170 digester heater is included in this plant which utilizes the existing Imhoff tank as a secondary clarifier, also providing a new trickling filter to supplement the old P.F.T. fixed nozzle unit.

WEST PLANT The P.F.T. Controlled Digestion System at this plant was developed by modernizing two existing unheated digesters with scraper mechanisms with two P.F.T. floating cover digesters and supplying heat with a P.F.T. #170 heater. The existing P.F.T. fixed nozzle filter and final clarifier were used without change.

SOUTH PLANT A completely new P.F.T. Contolled Digestion System with a 35' P.F.T. floating cover and #100 digester heater replaces the old septic tank at this plant. The old contact filters were converted to sludge beds.



All three plants now embody the ultimate in modern "P.F.T. Controlled Digestion" systems including P.F.T. floating covers, P.F.T. supernatant selectors, P.F.T. digester heaters and P.F.T. gas safety equipment. All three digester heaters are also arranged to automatically supply the building heating requirements.

P.F.T.

PACIFIC FLUSH TANK CO.

Waste Treatment Equipment Exclusively Since 1893

4241 RAVENSWOOD AVE. CHICAGO 13, ILLINOIS

NEW YORK • LOS ANGELES • SAN FRANCISCO • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

(*Continued from page 86A*)

Honor of the American Institute of Mining and Metallurgical Engineers in recognition of his 50 years of service as a member. This citation took place in St. Louis, Missouri, at the 171st annual meeting of the Institute.

Cold Galvanizing

A New Protective Material Applied Like Paint

504

Chase Chemical Corp., New York, N.Y., has developed a new method of cold galvanizing for surface protection of steel and iron. It is claimed that extensive testing over a two-year period has proved that the process, which utilizes Zinkrich Cold Galvanizing Compound, equals and in many cases exceeds the performance of other surface protection techniques including electroplating, hot-dipping, cementation, spraying and painting.

Zinkrich, when applied to steel or iron surfaces, creates an electrochemical union, thus allowing the zinc to become galvanized to the base metal's surface. The company points out that their product differs basically from so-called metallic paints as it actually combines with the steel or iron and leaves a coating of 96 parts by weight of chemically pure zinc. In cases where it is applied directly onto adhering rust, it induces the rusted area to create its own protective, non-flaking coating, arresting further rust and—preventing "Rust Creep."

Zinkrich is applied with an ordinary paint brush, electric spray gun or cold dip. No special equipment or personnel training is necessary.

WARREN
Solves Your
PIPE
PROBLEMS
BELL & SPIGOT PIPE •
FLANGE PIPE •
MECHANICAL JOINT PIPE •
FLEXIBLE JOINT PIPE •
SPECIAL CASTINGS •
SHORT BODY BELL & SPIGOT SPECIALS •
Warren Cast Iron Pipe and Fittings can be supplied in all sizes 2" to 84" with all types of joints and in accordance with Standard Specifications. Specify "Warren Pipe" for your next job.
Take advantage of our large stock of non-standard patterns, when in need of special castings to meet your individual requirements.
Warren
FOUNDRY & PIPE CORP.
55 LIBERTY ST. — N. Y. C.
WARREN PIPE CO. of MASS. INC.
75 FEDERAL ST., Boston, Mass.

Wm. J. Weed
Mgr. Sales

L. E. Bauer
Mgr. Production

Niagara Alkali's Two New Vice Presidents

Niagara Alkali Co., New York, N.Y., has announced that William J. Weed, Manager of Sales, and Louis E. Bauer, Manager of Production, have been elected vice presidents of the company.

Mr. Weed joined the company in 1913 and has served as a director since 1941. He is a past trustee of the Chemists' Club of New York, and a member of the New York Board of Trade, Synthetic Organic Chemical Manufacturers Association, Sales Executives Club of New York, and other organizations.

Mr. Bauer, who graduated from Brown University in 1916, is a member of the Niagara Falls section of the American Chemical Society, and of the Chemists' Club of New York. With his election as vice president of Niagara Alkali, Mr. Bauer also becomes a director of the company.

This announcement was made by S. Willard Jacobs, one-time Supt. of Filtration at St. Louis, who is Executive Vice-Pres. and Genl. Mgr. of Niagara Alkali.

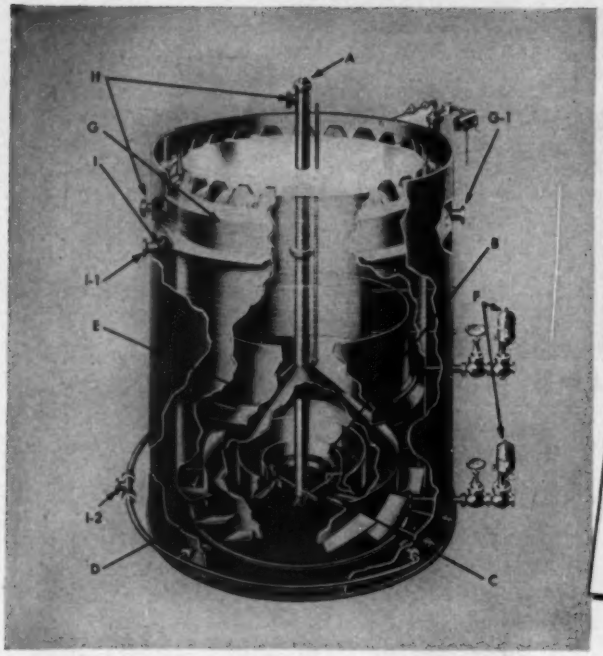
Rubber Lined Emergency Service Valve

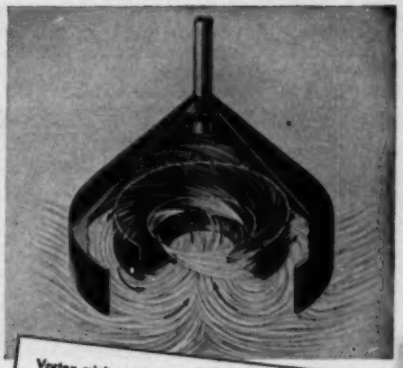
505

R-S Products Corp., Philadelphia, Pa., has developed a heavy duty cast iron rubber seated valve "No. 763" for emergency shut-off service. With the angular seating vane for wedge type closure, the rubber is compressed around the periphery of the vane to give positive shut-off even around the

(*Continued on page 90A*)

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.





Vortex mixing eliminates need for submerged moving parts in the Worthington Cold Process Slurry Type Precipitation Water Softener and Coagulator.

REACTION TANK of Worthington Slurry Type Softener (Slurry bed eliminated for clarity). (A) Raw water influent line. (B) Vortexor for optimum slurry production. (C) Chemical Applicators. (D) Slurry bed rotator. (E) Symmetrical Slurry concentrator. (F) Proportionate sludge removal. (G) Collector trough for treated water. (G-1) Treated water effluent. (H) Complementary recirculation. (I) Filter wash water compartment. (I-1) Filter wash water suction. (I-2) Filter wash water return.

This slurry bed stays put!

. . . and troublesome variables are out

These Features Give You The Uniformity You Want

WORTHINGTON SLURRY TYPE PRECIPITATING WATER SOFTENER AND COAGULATOR gives consistent, uniformly softened water

If it's clear, uniformly softened water you want, this unique Worthington Water Softener is just what you need. Concentrated quick mixing and rapid recirculation of applied chemicals and raw water, *achieved by hydraulic energy instead of submerged mechanical moving parts*, is an important, progressive development in the water treatment field.

New Bulletin W-212-B5 gives you 16 pages of vital facts about this unique cold process water softening method. Write for your free copy today.

REMEMBER . . .

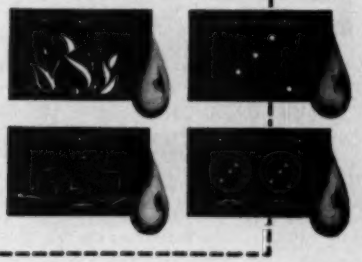
Worthington engineers *all four* water conditioning processes; therefore, can give you unbiased recommendations on which process is right for you . . . further proof that *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Water Treating Division, Harrison, N. J.*

30.1

WORTHINGTON

WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems



(*Continued from page* 88A)

shaft bosses. This type of construction makes it possible to use an iron body valve where stainless steel of other alloy would normally be called for. The rubber flanges take the place of the usual flange gaskets.

R-S Valve—763, in sizes from 2 to 72 in., is completely cycled and operated by a directly connected motor driven pump, sealed in oil. The hydraulic pressure raises the counterweight for the open position. When the valve is fully open an integral switch cuts off the operating motor. During the time that the operator is energized current consumption drops to a minimum. Should current fail the oil operator is released, the counterweight drops, and the valve closes.

Worthington Appoints Fraser Midwest Sales Manager

Worthington Pump and Machinery Corp., Harrison, N.J., through W. H. Feldman, vice president in charge of sales for the company, announces that A. William Fraser, formerly General European Manager, has been appointed Midwest Sales Manager. Fraser will direct the sales of Chicago, St. Paul, Kansas City and St. Louis offices, making his headquarters in Chicago.

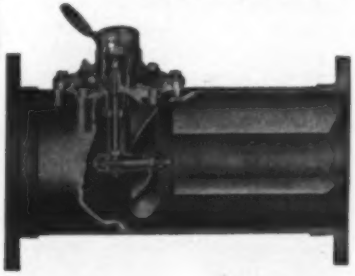
After graduating from Northeastern University with degree of Bachelor of Mechanical Engineering, Fraser joined Worthington's training course in 1929 and became sales engineer in various Worthington offices and plants throughout the country. In 1937, he became Chicago District Manager and in 1945 General European Manager.

SPARLING MAIN-LINE METERS

for the Information You NEED!

Once you install a Sparling Meter on a main line and KNOW what is going on, you will want to meter your other mains. Operators *need* the information a meter gives, and will usually find a Sparling Meter pays for itself!

SIZES FROM 2-INCH UP



Every Sparling Meter is a complete Totalizing unit, easily installed by your own men. Indicators, Recorders and Controls are added as desired.

Quotations and Bulletin 311 come at your request

SPARLING METER COMPANY
INCORPORATED

LOS ANGELES 54.....Box 3277
CHICAGO 8.....1500 South Western Ave.
BOSTON 8.....6 Beacon Street
DALLAS 1.....726 Reserve Loan Life Bldg.
626 Broadway.....CINCINNATI 2
101 Park Avenue.....NEW YORK 17
1932 First Avenue.....SEATTLE 1
66 Luckie Street N.W.....ATLANTA 3

Drainage Structure Slide Rule Calculator

506

Armco Drainage & Metal Products, Inc., Middletown, Ohio, has made available a new slide rule Drainage Calculator for determining the right size and shape of drainage structures.

Knowing the runoff index and the number of acres to be drained, a single setting of the slide determines the required cross-section of structure and indicates the correct size of round pipe, Pipe-Arch and Multi-Plate.

It shows the various Multi-Plate Arches which can be used and a table listing arch dimensions facilitates the selection of an arch with a suitable span and rise.

All calculations are based on Talbot's widely accepted formula and a maximum rainfall of 4 inches.

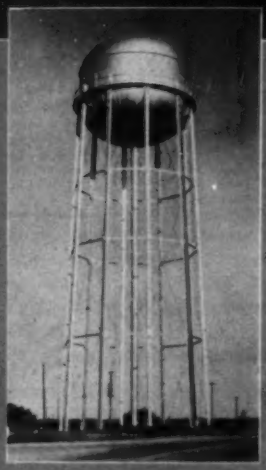
(*Continued on page* 92A)

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

PITTSBURGH • DES MOINES

Stands for

BETTER WATER SERVICE *with* ELEVATED STEEL TANKS



Ample supply for peak demands—dependable, uniform pressures—reserve capacity for fire protection and pump interruptions . . . these and every other feature of desirable water service are gained through the right Pittsburgh-Des Moines Elevated Steel Tank for specific community needs. Determination of correct tank type and size is simplified by a consultation with experienced P-DM engineers. *Let us cooperate!*

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25), . . . 3418 Neville Island
NEW YORK (7), . Room 918, 270 Broadway
CHICAGO (3), 1222 First National Bank Bldg.
DES MOINES (8), ... 919 Tuttle Street
DALLAS (1), . . . 1223 Praetorian Building
SEATTLE . . . . . 926 Lane Street
SANTA CLARA, CAL. . . 625 Alviso Road

The DRIVE
that assures you
continuous sewage service

JOHNSON
Right Angle
GEAR DRIVE
for Sewage Applications

HEALTH PROTECTION . . . Dependable for continuous 24 hour constant service.

AVAILABLE . . . Manufactured in sizes, types and ratios to meet varied applications.

DEPENDABILITY . . . High efficiency and all-weather service. Low operating cost.

WORLD WIDE ACCEPTANCE . . . In recognition of dependable service, economy of operation and maintenance. Hundreds now in use by municipalities.

INVESTIGATE NOW . . . Get the facts on the Johnson Right Angle Gear Drive. Send for illustrated catalog.

PHOTO: Type 3 — automatic dry pit municipal sewage installation at Stratford, Connecticut—electric motor or engine drive.

JOHNSON GEAR AND MANUFACTURING CO.

"45 years of Engineering Service"

8th & Parker Streets • Berkeley 10, Calif.

(*Continued from page 90A*)

Corrections for other rates of rainfall are easily made by simple movement of the slide.

This handy tool for drainage engineers is a convenient pocket size and made of heavy enameled paperboard for durability. It is free for the asking.

F-M Advances Woodruff to Pump Dept. Manager

Fairbanks Morse & Co., Chicago, Ill., has announced the advancement of T. E. Woodruff from Assistant Manager to Manager of the Pump Division with headquarters in Chicago. He succeeds D. T. Johnstone, who assumes the duties of Pump Department Manager of the Company's San Francisco Branch House.

Mr. Woodruff has been associated with Fairbanks Morse & Co., since 1912. Following service with the A.E.F. in World War I, he was graduated in 1926 from Iowa State College with a B.S. degree in Civil Engineering. For the past year and a half he has been Assistant Manager of the Pump Division.

Pocket Calculating Machine

507

Precision Instrument Co., New York, N.Y., is offering a new, low priced pocket adding machine that is a handy, easy-to-carry, easy to operate

(*Continued on page 94A*)

TENNESSEE CORPORATION
Ferri-Floc
FERRIC SULPHATE

TURBIDITY

Ferric Salts have proven their ability to coagulate water of widely varying turbidity. Spring rains will bring about turbidity for those who must treat surface supplies. The use of Ferri-Floc will simplify the treatment of this high turbidity. Ferri-Floc is a partially hydrated Ferric Sulphate that has the ability to convert these high turbidities without radical dosage changes.

A large filtration plant superintendent has this to say, "For coagulation of high turbidity with a high PH we have found ferric sulphate to be superior in all cases and we would not hesitate to recommend it."

SULPHUR-DIOXIDE
HIGHEST QUALITY
SO_2

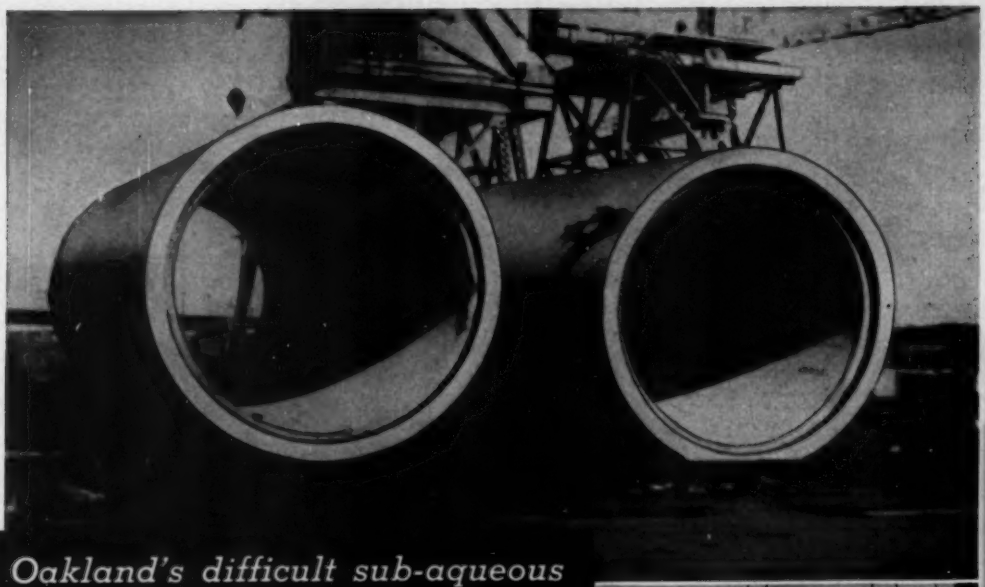
Sulphur Dioxide is effectively used in water treatment to remove objectionable odors remaining after purification.

FREE BOOKLET

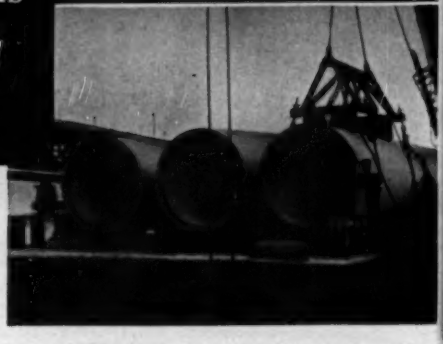
A postal card or letter will bring you our booklet on the advantages of FERRI-FLOC — Tennessee Corporation, Grant Building, Atlanta, Georgia, or Lockland, Ohio.

TENNESSEE CORPORATION

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.



Oakland's difficult sub-aqueous outfall sewer problem solved with ***CONCRETE PIPE***



Buried beneath 40 feet of water near the famous San Francisco-Oakland Bridge is another great engineering achievement. This is the sub-aqueous section of the outfall of Oakland's East Bay Municipal Utility District and consists of 5,970 feet of 96-in., i.d. reinforced concrete pipe. This giant sewer pipe was cast in 24-ft. lengths with walls 9 in. thick, each length weighing 39 tons.

In placing this great outfall the engineers faced many difficulties—bay bottom mud deposits ranging from 7 to 40 feet which had to be excavated, water temperatures of 50 to 55 degrees, heavy tides, pipe that had to be placed and aligned with divers and backfilled under water.

This is another example of how concrete pipe can be used to solve difficult or unusual sewer problems. In thousands of installations over scores of years, concrete pipe has demonstrated its rugged durability, great structural strength, maximum hydraulic capacity, minimum infiltration and leakage, and its tremendous resistance to wear from all types of abrasive matter.

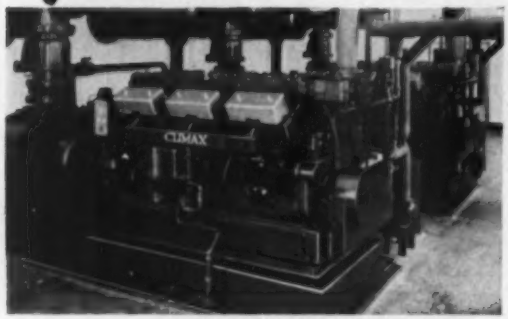
Concrete pipe is moderate in first cost, requires little or no maintenance over the years and serves far longer. The result is real *low-annual-cost* sewer service.

Large photo above shows two 24-ft. sections of reinforced concrete sewer pipe on the bay shore dock before being loaded onto a barge for towing to the job site. Small photo above shows pipe being lifted from the barge at the job site. Photo below shows pipe section being lowered into place. Note how redwood checks were used in giving the concrete pipe its final line check after it was placed.

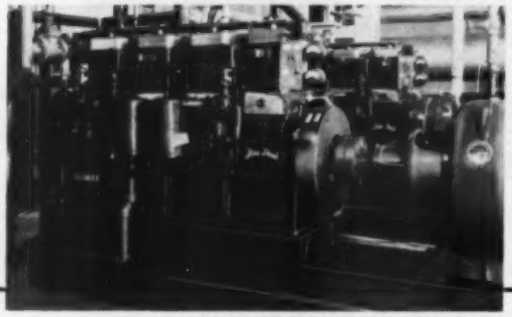
AMERICAN CONCRETE PIPE ASSOCIATION

228 NORTH LA SALLE STREET CHICAGO 1, ILLINOIS

climax PERFORMANCE



Climax Blue Streak V-120, 198 H.P., 12 Cylinder, V-Type Sewage Gas Engines Direct Connected to Blowers.



Climax Blue Streak R-6T, 100 H. P., 6 Cylinder, Vertical Sewage Gas Engines Direct Connected to Pumps. Both Installations in Boise, Idaho.

climax BLUE STREAK ENGINES

utilize by-product Gas . . .

TODAY hundreds of Climax Engines installed in sewage plants are operated efficiently on sewage gas delivering continuous 24-hour service at a minimum maintenance expense. Selected to do the job because of their unmatched dependability, quality construction, slow speed and conservative rating. Built by Climax, a manufacturer with 38 years' engine experience.

Climax Blue Streak Sewage Gas Engines are four-cycle, multiple cylinder type for continuous duty, in sizes from 40 to 250 H. P. For emergency use in water works, gasoline engines are available in sizes 40 to 600 H. P.

Write for complete information and service record of Climax Engines to: Climax Engine & Pump Mfg. Co., 208 S. La Salle Street, Chicago, Illinois.

climax ENGINE AND PUMP MFG. CO.

Factory and General Office Clinton, Iowa

Regional Offices Chicago - Dallas - Long Beach, Cal.

(*Continued from page 92A*)

machine that fits into your pocket or a corner of your desk drawer. Fitting into the palm of the hand, it will add and subtract up to 99 million with a flick of the finger.

This attractively priced device measures only 3 x 5 inches x ¼ inch thick. Although weighing but 5 ounces, the "Kalkometer" is sturdily constructed of tough plastic and steel and comes in a neat pocket carrying case, about bill-fold size. Stating that the calculator should last a lifetime, Precision Instrument Co. guarantees that any "Kalkometer" wearing out within 5 years from date of purchase, regardless of extent of use, will be replaced with a new one.

As we see it, anyone needing an inexpensive adding and subtracting machine for personal use should investigate the "Kalkometer" further.

Applebaum Made Head of Water Treatment Division by Cochrane

Cochrane Corp., Philadelphia, Pa., has announced the appointment of S. B. Applebaum as manager of its Water Treatment Division. Applebaum, who has specialized in water conditioning for more than 35 years, joined Cochrane in 1949, since which time he has been manager of the Cold Process section of the Water Treatment Division. He was founder and is vice-president of Liquid Conditioning Corp., now a subsidiary of the Cochrane Corporation.

Builders Makes Hartley a Vice President

Builders-Providence, Inc., Providence, R.I., at the annual meeting of the Board of Directors elected John R. Hartley as Vice President of

(*Continued on page 96A*)

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

*When pipe life is too short...**

The age-old problems of maintenance and replacement are solved when you specify CARLON plastic pipe for municipal water systems, sewage disposal, land drainage and other medium-pressure, low temperature applications.

CARLON plastic pipe is guaranteed against rot, rust and electrolytic corrosion. It will not accumulate scale or sediment, is inert to the action of corrosive soils and waters, and features a projected service life many times longer than ordinary pipe.

CARLON plastic pipe is furnished in random 21-foot threaded and coupled sections. To meet individual job requirements, this new CARLON plastic pipe can be cut to desired length and threaded with standard pipe dies.

A complete line of CARLON plastic fittings, reducers and plugs is available to permit complete corrosionproof plastic installations as well as connection to fixtures and previously installed metallic lines.

When pipe life is too short, eliminate costly maintenance and replacement problems . . . Specify CARLON—The first real pipe that is plastic!

At present, raw material shortages are limiting the production of certain types of CARLON pipe. Every effort is being made, however, to overcome this problem and to meet the demand and need for CARLON plastic pipe.

*** SPECIFY CARLON—the first real pipe that is plastic!**

CARLON CP 120-CP

CARLON PRODUCTS CORPORATION

IN CANADA: MICRO PLASTICS, LTD., ACTON, ONTARIO

10132 MEECH AVENUE • CLEVELAND 5, OHIO

ROTO-TROL

RS-3

Sump Control

PRESSURE TYPE

Operates with equal success in wet wells containing either clear water or raw sewage. Used only for pumping out of a wet well.

No moving parts in the wet well. No floats to bind, no parts to lose their conductivity, nothing that will plug rapidly, due to building up of sludge. The standard *RS-3* controls one to six pumps discharging from the same wet well. Voltages of 110 to 440, A.C. *RS-3* can be mounted anywhere on wall or switchboard.

Write for performance and engineering data

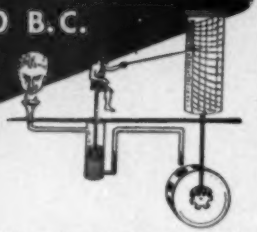
Water Level Controls Division

HEALY-RUFF COMPANY

783 Hampden Ave., St. Paul 4, Minn.

WATER at WORK

250 B.C.



A far cry from modern applications, this unique time piece known as the Water Clock of Ctesibius was operated by tears flowing from the eyes of a statue. The Pointer descended once in 24 hours, actuated by an automatic siphon.

for excellence in **MODERN** water treatment equipment — gravity and pressure filters — recirculation apparatus

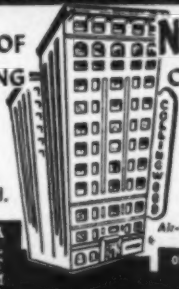
ROBERTS FILTER MANUFACTURING CO.

601 COLUMBIA AVE., DARBY, PA.

TWELVE STORIES OF SPACIOUS COMFORT LIMITED TO 500 GUESTS

AT THE HEART OF SMART SHOPPING

NEW YORK'S CENTER!



Enjoy the hospitality of a wayside inn at this modern ideally located hotel.

EVERY ROOM WITH PRIVATE BATH AND SHOWER

Near Penn. Station and all points of interest.

Air-Conditioned restaurants and cocktail lounge

SAKS · McCREERY · ALTMAN · OPPENHEIM COLLINS · R. H. MACY · GIMBELS

COLLINGWOOD

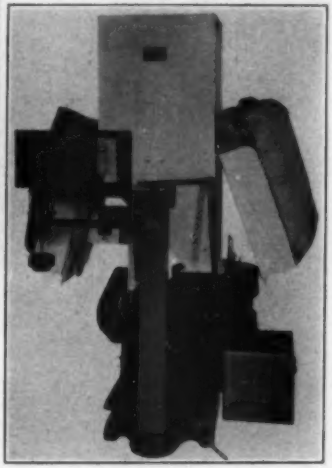
Just West of FIFTH AVE. on 35th St.

AL SCHWARTZ *Managing Director* — A. LAWRENCE PRINCE *Resident Manager*

(*Continued from page* 94A)

the company. Mr. Hartley has been associated with Builders for 23 years, the last three of which he has been Manager of Project Sales. Prior to that time, he was a sales engineer. He began his work with the company as an apprentice draftsman. Mr. Hartley will continue in charge of Engineered Project Sales both in water and sewage fields and in the problems of water and waste treatment in a variety of industries.

He is a member of the Boston Society of Civil Engrs., the Providence Engineering Soc., the Am. Water Works Assn. and the Federation of Ind. Wastes & Sewage Wks. Assns.



Omega's Improved Fluoridizer

508

Omega Machine Co., Providence, R.I., has announced a new and improved Fluoridizer for the feeding of fluoride chemicals to water.

New features of this scale mounted feeder include large hopper capacity, dustless filling, and low filling height. To avoid the need for frequent filling, this new hopper will hold two 100 lb. bags of fluoride or one 125 lb. drum carton.

Dust production during filling is eliminated by preventing the fall of chemical through the air. The chemical is added at the bottom of the hopper. A bag of chemical is placed on the hopper door, slit open at the top, skewered in place, and the door merely easily lifted and closed, allowing the chemical to fall but a short distance into the hopper. The low filling height is accomplished not only by lowering the hopper since the dissolver chamber is off the scale, but also by the ingenious method of placing the

(*Continued on page* 98A)

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •

RUGGED Simplicity

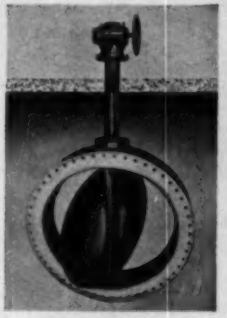
Correctly engineered mechanically and metallurgically, all body assemblies of R-S Valves equal or exceed A. S. A. standards in every detail. These valves are designed and constructed for rugged service and provided with such safety factors that they will exceed service expectations as well as reduce pumping and blower costs.

Consider also the few working parts, greater control rangeability, the self-cleaning feature and the fact that R-S Valves are readily adapted to automatic operation. Know the rugged simplicity of R-S Valves, and get the most from your valve investment.

District offices are listed in telephone directories as, "R-S Products Corp'n Valves".

R-S PRODUCTS CORPORATION
4600 Germantown Avenue, Philadelphia 44, Pa.
An S. Morgan Smith Company Subsidiary

No. 782—Heavy Duty Rubber Seated Wafer Type Valve with 5° angle seated vane and enclosed gear reduction drive. Gland can be removed and stuffing box repacked without removing prime mover.



No. 739-740—Sixty-inch, 50-pound Heavy Duty Valve with gear reduction drive and handwheel for handling water at 40 psig. Vertical valve stem enclosed in steel pipe support. Thrust bearing absorbs vertical load.

No. 730—R-S Heavy Duty Floor Stand for rugged service in connection with any standard R-S handwheel operated valve.

No. 767—A 3-Way Valve (Two 24-inch 125-pound Cast Iron Valves bolted to 125-pound American Standard Tee). Electric motor operated by cross linkage. Automatic declutching handwheel for emergency operation.

DEPENDABLE

Marlow Pumps... *preferred from coast to coast!*

PLUNGER SLUDGE PUMPS

Bulky debris and nearly solid sewage wastes are routine for these rugged, trouble-free units. In four sizes and two types. Any capacity required.

SELF-PRIMING CENTRIFUGALS

Prime automatically, virtually clog-proof. You can rely on these able pumps for low-cost, low maintenance service with clear or semi-clear fluids. From small portables to units of 240,000 GPH capacity.

MARLOW MUD HOGS

The diaphragm pump that can't be beat for handling mud-filled or trash-laden liquids. Extra heavy construction. Capacities to 9000 GPH. Ask especially for details of the new lightweight Mud Hogs.

For complete details see your Marlow distributor or write the factory.

MARLOW PUMPS

243 GREENWOOD AVENUE
RIDGEWOOD, NEW JERSEY

THE STANDARD OF THE INDUSTRY

(*Continued from page 96A*)

bag or carton on the hinged side door to the hopper.

In addition to these new and improved features, the Fluoridizer has accuracy of feed, check of quantity fed, positive volumetric displacement, simple mechanism and drive, simplified lubrication, wide feed range, percentage adjustment feed scale, and engineered design to allow either large or small dissolvers. The above illustration shows the Fluoridizer with both hinged doors loaded with bags which will be upended and dumped when doors are closed.

New Low Capacity Hypochlorinator

509

Wallace & Tiernan, Newark, N.J., has introduced the "Chlorinet," a new, low capacity electrically operated hypochlorinator, designed for feeding hypochlorite or fluoride solutions to small pumped water supplies.

Ease of operation and dependability are the main features claimed for the "Chlorinet." No special knowledge or tools are necessary for installing or operating the unit. A clear plastic pumping head and sight glass permit the operator to see at a glance that the feeder is operating. The feed rate is easily changed by a feed adjustor knob. A visible pointer indicates the feed rate at all times.

Shipped as a package unit complete with tubing and pipe connection, the "Chlorinet" will feed against either a vacuum or pressures up to 100 p.s.i. without any special fittings.

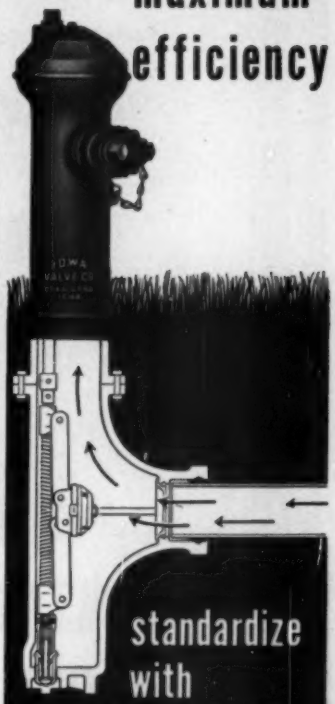
Roots-Connersville Announces

Johann as Sales Manager; Roudebush, Works Mgr.; Caudle Asst. Sales Manager

Robert A. Owens, president, Roots-Connersville Blower Corp. of Connersville, Ind., announces the promotion of E. P. Roudebush to Works Manager, in charge of all pro-

(*Continued on page 100A*)

for maximum efficiency



Two piece operating nut with special adjustment screw solves the problems of expansion and contraction . . . makes Iowa hydrants easy to operate at all times.

Positive operating mechanical drain valve can be removed along with all other working parts through top of hydrant without special tools.

Fixed position of valve arms makes leaking impossible should standpipe be broken.

Unrestricted water flow gives full pressure at extreme low loss of head.

Built to conform to the latest A.W.W.A. specifications.

IOWA VALVE COMPANY

201-299 N. Talman Avenue • Chicago 80, Illinois

A subsidiary of James B. Clow & Sons

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

SIMPLICITY of AMERICAN METERS

THE DISTINGUISHING FEATURE

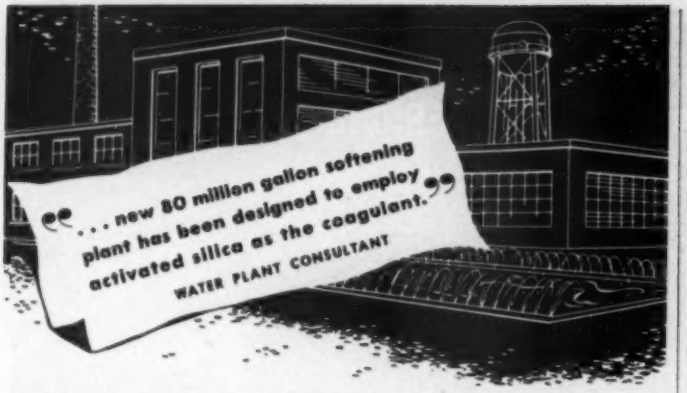
All water meters are sold today under approximately the same claims of quality and accuracy. How then shall a buyer choose intelligently the best meter? Price may or may not be a criterion.

The one important variable among water meters today is simplicity of design. The meter which does its work with the fewest parts is the most efficient, the most advantageous over many years. That meter is the American.

Ask for complete data.

BUFFALO METER CO.

2909 MAIN STREET, BUFFALO 14, NEW YORK


"... new 80 million gallon softening plant has been designed to employ activated silica as the coagulant."
WATER PLANT CONSULTANT

Seven years' experience in lime-soda softening operations keeps N-Sol Activated Silica the #1 coagulant. The flocs formed are large and tough, removing more impurities to produce clearer water of high quality. Filter runs are increased; in some instances, doubled. Alum is used with the activated silica sol, although in certain instances it can be eliminated.

N-Sol Activated Silica is made by reacting N® Silicate with ammonium sulfate, chlorine, alum or sodium bicarbonate.

PHILADELPHIA QUARTZ COMPANY
Manufacturers of Soluble Silicates
1166 Public Ledger Bldg., Philadelphia 6, Pa.

N-SOL PROCESSES FOR WATER COAGULATION

CEMENT GUN COMPANY PRE-STRESSES AND RESTORES *EXISTING* WATER TANK

The progress picture above shows a stage of our repair work on a concrete water tank in New England. This tank was completely lined with reinforced "GUNITE" to stop seepage which had caused serious disintegration to the exterior of the tank. The entire outside of the tank was subsequently chipped and existing hoop rods exposed.

To strengthen the tank, wedges were driven behind the rods to take up the slack. This placed the rods in tension and the concrete in direct compression. Wire mesh was then attached to the reinforcing rods and the entire tank treated with two inch mesh reinforced "GUNITE."

The use of "GUNITE" for repair and construction of reservoirs, bridges, buildings, etc., is illustrated and described in Bulletin C 2400. We will gladly send a copy at your request. On your letterhead please.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA. U.S.A.
MANUFACTURERS OF THE CEMENT GUN

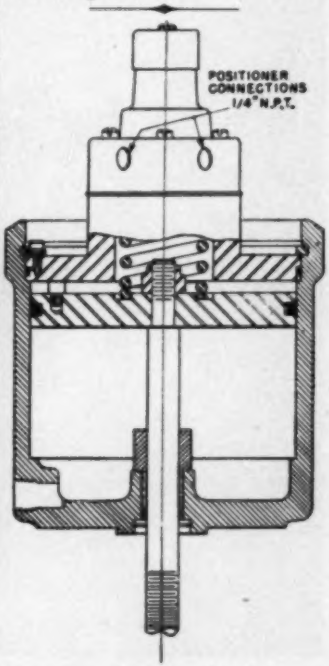
(Continued from page 98A)

duction activities; D. A. Johann to Sales Manager, in charge of all sales and advertising; and, A. E. Caudle to Asst. Sales Manager.

Roudebush is a native of Ohio and a graduate of Ohio State University. In 1944 he joined the parent company, Dresser Industries, Inc., as Director of Industrial Engineering, coming to Roots-Connersville in January 1950, as assistant to the Vice President-in-Charge of Manufacturing.

Johann, a graduate of Pennsylvania State College, joined Roots-Connersville in 1946 as Manager of the Chicago District Office.

Caudle is a graduate of Oregon State College. From 1926 to 1946 he was engaged in the design and application of centrifugal blowers, and joined the Roots-Connersville organization in July 1946, as Chief Application Engineer.



Pneumatic Cylinders for Throttling Control

510

Conoflow Corp., Philadelphia, Pa., has announced the B-50 Series of pneumatic cylinders for throttling control service. These lightweight positioning devices have already been applied to the Link Belt P.I.V. drive unit, Lapp Isulator adjustable stroke chemical pumps, and Proportioneers chemical feeders, as well as various

(Continued on page 102A)

If interested in equipment or literature mentioned above, mail a Reader Service Card with your name, address, and item key number.

Designs from engineers' notebooks

Sludge Digestion Tank Relief Valve in EVERDUR

This relief valve was especially developed by Nussbaumer, Clark & Velzy of New York and Buffalo to relieve upward pressure on a concrete sludge digestion tank when ground water level becomes so high that flotation of the tank might otherwise occur.

The engineers point out that the critical elements in this unit and its application are the valve seat and the restraining bolts. For these, EVERDUR® was specified because of its excellent resistance to corrosion and its great strength.

Everdur (ANACONDA Copper-Silicon Alloys) long ago proved its economy and durability in water and sewage works equipment under severely corrosive operating conditions. These easily welded alloys make possible the use of lightweight wrought assemblies which provide exceptional ease of operation as well as long, rust-free service.

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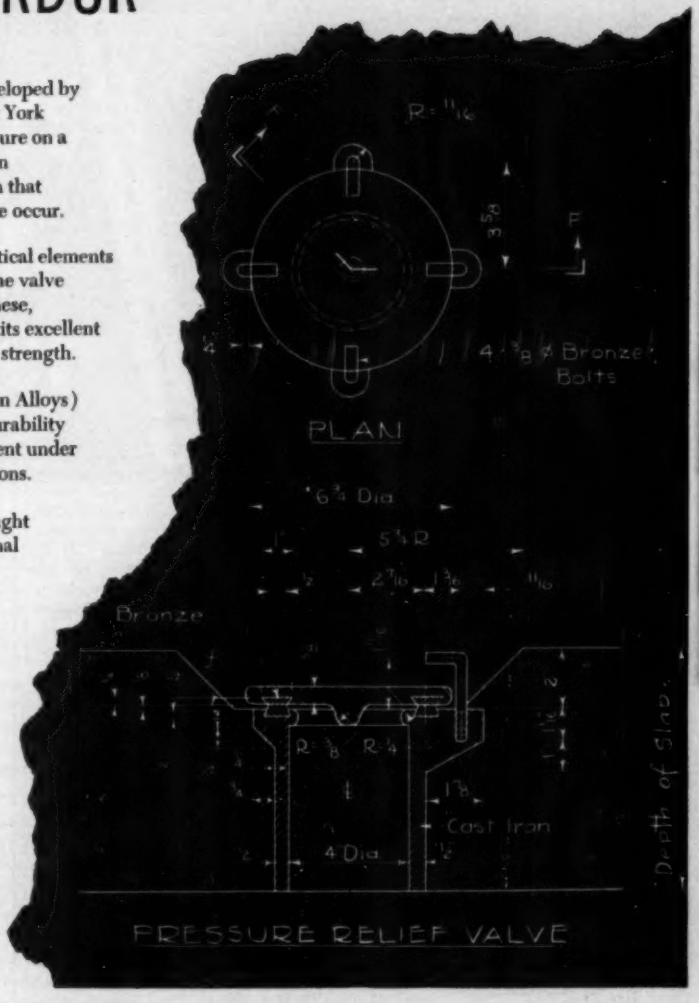

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GK sewer jointing compound

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Over a half century of service

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MINERAL PRODUCTS COMPANY
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(Continued from page 100A)

electric components and sliding stem valves.

The B-50 cylinders consist essentially of a new design of "O" ring sealed pneumatic cylinder with a piston positioner integrally mounted in the head plate. The cylinder itself is a bucket-type made of cast aluminum. A one-piece piston is fitted with a graphite-impregnated "O" ring, providing a perfect seal with a minimum of friction. Head plate and piston stem are also "O" ring sealed, eliminating head bolts and gland packing.

The positioner is integrally mounted on the head plate, and takes its position by means of a contact spring riding on the piston. The B-50 Series are suitable for use with air supply pressures up to 100 P.S.I.G. and are capable of repositioning accuracies up to 1/500th part of the total travel.

Hooker Makes Babcock a Vice President

Hooker Electrochemical Co., Niagara Falls, N.Y., at the annual meeting of the board of directors elected J. Herbert Babcock a Vice-President. The announcement was made by R. L. Murray, president, who at the meeting appointed Mr. Babcock as vice-president in charge of development and research. At the same meeting, Charles H. Winkler was made assistant treasurer of the Hooker Co. and Thomas F. Willers was made comptroller.

Mr. Babcock started with the company in 1916 as a research chemist, and was engaged in both production and sales of fine organic chemicals until he became manager of research in 1933. From 1949 until his present appointment he has served as director of development and research.

Personnel Changes in Dearborn Chemical

Dearborn Chemical Company, Chicago, Ill., has announced the following changes in the sales organization due to retirements, promotions and additions. Two new managers in Dearborn's Eastern Division, with headquarters in N.Y. City, have been appointed. C. S. White will head

St. Louis
Turbidimeter

For measuring turbidity of water. Consists of cast aluminum housing, adjustable lamp . . . two vertical wells for holding two Nessler tubes.

This apparatus, comes ready to plug into 115 volts line, comes fully equipped for normal operation.

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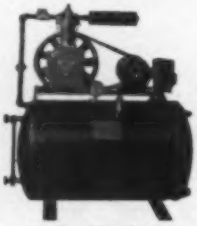

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Portland, Ore., contractor reports:

Chas. T. Parker, of Parker-Schram Co., says: "On this 36" pipe line using Dresser Couplings, a foreman, crane operator, oiler and six-man crew were able to average 15 lengths per day, complete except for coating. This in spite of almost incessant heavy rains. Where ditch was available without obstruction, we were able to complete about five lengths per hour. We know of no better method of connecting lengths of pipe in a water line."

A Dresser-Coupled steel line

delivers water cheaper

The cheapest way to deliver water to the place where it turns into revenue is with a Dresser-Coupled steel line—the line that cuts *installation* costs, *leakage* losses and *maintenance* costs.

As in the case of this Portland water main, construction of a Dresser-Coupled line keeps going despite adverse weather conditions. Because a wrench is the only tool needed to make joints, costly weather delays are minimized or eliminated. And, in good weather, this type of construction sets a pace no other method can equal. The line starts paying its way sooner.

Leakage losses are cut because Dresser Couplings stay "flexible-tight" for the life of the line. Controlled gasket pressure is provided by controlled bolt tightness around the joint.

Maintenance costs are reduced also. Dresser Couplings harmlessly absorb underground stresses; and modern glass-smooth pipe linings, undamaged in joining because there's no heat, assure sustained high carrying capacity.

From all standpoints, a Dresser-Coupled steel line gives you the ultimate in performance and economy. See your Dresser Sales Engineer or write our Bradford Office for literature.

BE SURE you get the best line at the best price. Put steel pipe and Dresser Couplings in your specifications.

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TABLE OF COMPARATIVE QUANTITIES

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4	2.5	2.00	2.25	8.56
6	2.5	3.00	2.25	11.71
8	2.5	4.00	2.25	14.63
10	2.5	5.00	2.25	17.70
12	2.5	6.00	2.25	20.86
14	2.5	7.00	2.25	24.02
16	2.5	8.25	2.25	33.07
18	2.5	9.25	2.25	36.88
20	2.5	10.50	2.25	40.71
24	2.5	13.00	2.50	53.02
30	2.75	16.00	2.50	65.36
36	2.75	19.00	2.50	77.96
48	3.50	30.00	3.00	121.15
54	4.0	38.00	3.00	135.60
60	4.0	42.00	3.00	150.70

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SPRING VALLEY NEW YORK

the Water Treatment Department, replacing S. H. Opdyke who was retired January 1, and Howard E. Johnston becomes manager of "NO-OX-ID" sales, succeeding C. A. Remsen who passed away in January. White was formerly sales representative in the Iowa territory.

Amongst other Dearborn veterans retired on January 1 were C. I. Loudenback, Chicago, 32 years; M. M. Kutzer, Chicago, 32 years; and B. E. Conley, Texas, 26 years. Opdyke and Remsen had been with the company 38 and 36 years respectively.

Literature and Catalogs

Precise pH Control and Water Tests

511

Hellige, Inc., New York, N.Y., has just published a 12-page catalog entitled **"Precise pH Control and Water Tests."** The catalog describes and illustrates the Hellige Colorimetric Comparator line which ranges from the Simplex Testers to the versatile pocket and standard comparators, and the aqua tester.

The catalog states that all models are equipped with color plates, or colored discs, containing proved non-fading glass color standards. It also introduces the Hellige Daylite Comparator Illuminator with which the popular pocket and standard comparators can be used for determinations in both artificial light and day light.

Zeolite Softener With Single Control Valve

512

Cochrane Corp., Philadelphia, Pa., has just issued a new bulletin on Sodium Zeolite Water Softeners, headed **"Cochrane Zeolite Softeners, Featuring the Cochrane Hydromatic Single Control Valve."**

This publication gives a detailed explanation of the sodium zeolite softening process containing a definition of terms employed in this description, the data necessary for laying out a zeolite water softening plant, the factors governing the size of such equipment, the selection of zeolite material and a description of both siliceous zeolites and non-siliceous zeolites and a description covering the four steps in the operation of a zeolite softener.

(Continued on page 106A)

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SOUND PRINCIPLES OF WATER TANK MAINTENANCE and TANK TALK, by W. A. RILEY

—SAFETY—SERVICE—SATISFACTION—

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THE LARGEST ORGANIZATION OF ITS KIND GIVING SAFE MAINTENANCE AT LOW COST

(Continued from page 104A)

Included is a complete description of the unique single control valve, known as the Hydromatic Valve, characteristic of all Cochrane zeolite equipment with a detailed description covering construction of the entire zeolite softener equipment including accessories, regenerating equipment, etc.

Drainage Pipe

513

Armco Drainage & Metal Products, Inc., Middletown, Ohio, has published a new, illustrated folder entitled **An Economical Answer to Limited Headroom—Fast Runoff.**

It describes Armco Pipe-Arch and Multi-Plate Pipe Arch and shows why they carry more water than round pipe. Test data and case histories also show that these drainage products have more than sufficient strength to withstand both live and dead loads.

In addition the folder discusses erosion and corrosion problems and describes how Paved-Invert and Asbestos Bonded Pipe-Arch can be used to solve them.

Tables are included which give the recommended sizes and gages of both types of Pipe-Arch required to meet various loading conditions.

Tanktrols

514

Automatic Control Co., St. Paul, Minn., has just published a new **Autocon Tanktrol** Bulletin. This liberally illustrated, four-page bulletin explains the reasons for using two bellows for control instead of the ordinary single bellows design. It also outlines the results to be expected from this type of control, together with typical specifications.

Water Meter Repair and Testing Manual

515

Neptune Meter Co., New York, N.Y., has just published an informative new handbook titled **"Planned Meter Repair and Testing."** The handbook contains illustrated, step-by-step instructions for the repair and testing of Trident Split-Case Meters.

Similar in format and general content to Neptune's Frost-Proof Meter Repair Manual, the new 16-page booklet also contains complete instructions for setting up a meter repair shop, including photographs and floor plans of typical meter shops, a list of required tools and equipment, and suggested meter record forms.

Automotive Preventative Maintenance Manual

516

The basis for effective preventative maintenance of all mechanical equipment is the provision for regular inspection and servicing of such equipment rather than suffer from breakdowns before making repairs or replacing worn parts.

A scheduled maintenance routine insures maximum dependability of service, longer life and minimum maintenance cost for all automotive equipment. The maintenance procedures of the U.S. Navy are embodied in a 60 page manuel covering "Automotive Preventative Maintenance". For a copy send 30 cents (no stamps) to the U.S. Printing Office, Washington 25, D.C. requesting Catalog M-205.6-Au. 8/949.

Water Treatment

517

Philadelphia Quartz Co., Philadelphia, Pa., has issued a 12-page publication entitled **"Treatment of**

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Sluice Gates

518

Filer & Stowell, Milwaukee, Wis., has just published a 2-color, 40-page bulletin showing the company's complete line of **Sluice Gates.**

The bulletin, profusely illustrated with actual photographs and blueprint type drawings, discusses area of sluice gate openings; discharge through sluice gates; floorstands, dimensional and capacity data; floorstands, selection chart; installation of frame connections for sluice gates; operating mechanisms; sizes of sluice gates; dimensional tables and specifications for sluice gates.

Also included is complete information required for proposals or order regarding sluice gates.

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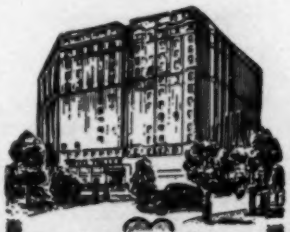

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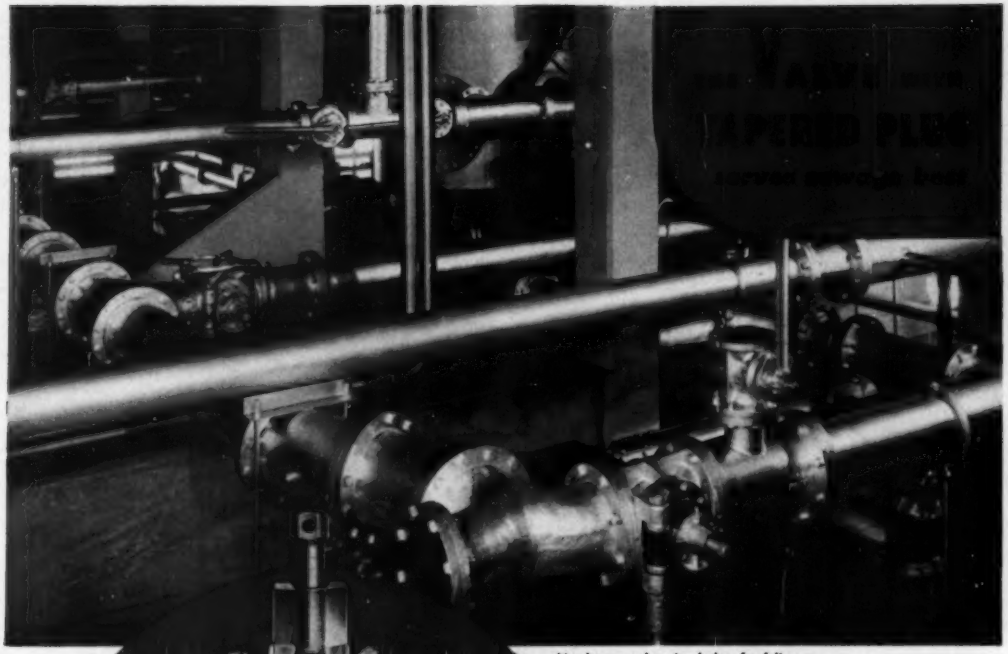

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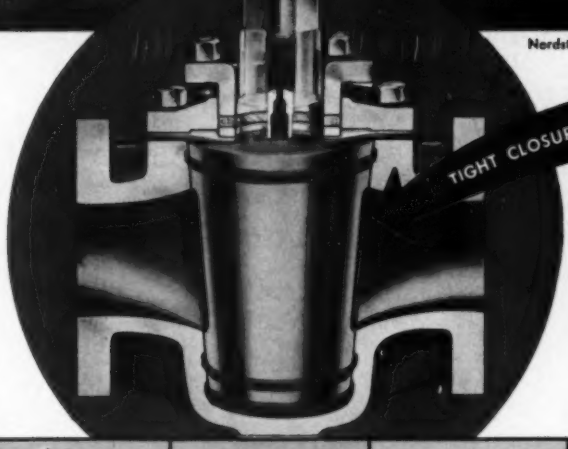

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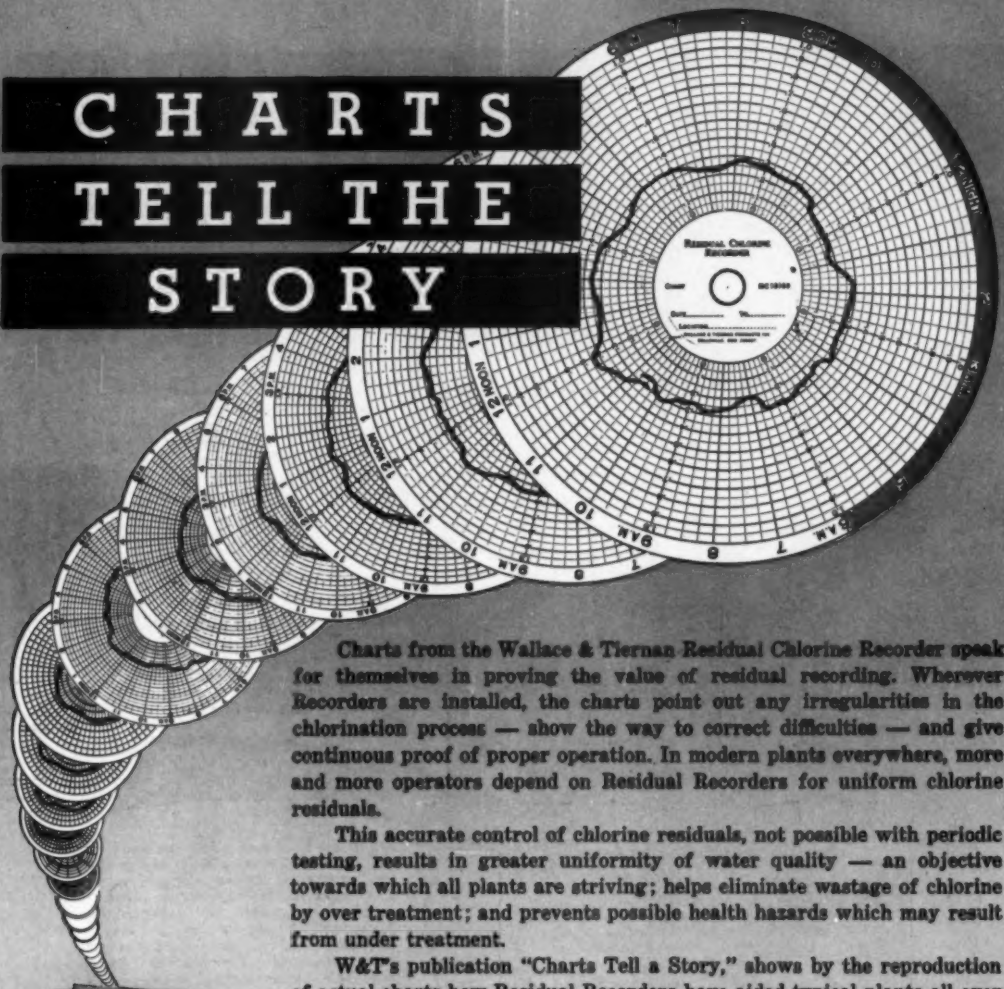

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